APRIL 1941 35 CENTS

AERO DIGEST

INCLUDING

AVIATION ENGINEERING

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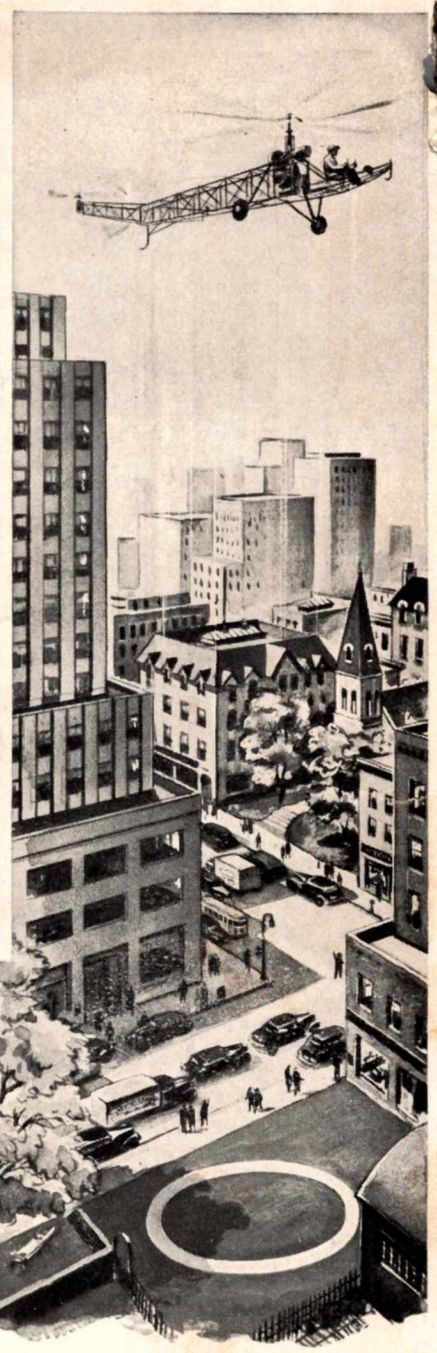
Superfinish
A Letter From England
Compass Deflection
Propeller Balance
More Plant Expansions
Airways Traffic Control

Test Pilot Lloyd Child and the U. S. Navy's 1700 hp Wright Cyclone Powered Curtiss XSB2C-1 Dive-Bomber



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AERO DIGEST *Volume 38* APRIL, 1941 *Number 4*

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AD-4

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An ABC Publication

VOLUME THIRTY-EIGHT NUMBER FOUR

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AERO DIGEST, 515 Madison Avenue, New York, N. Y.

I have checked by number(s), in the space(s) provided, the advertiser(s) in your _____ issue from whom I should like to obtain additional information. My aviation connection, which qualifies me for this service, is explained below

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Company or other aviation connection _____

Position or other aviation interest _____

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City _____ *State* _____

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All requests are forwarded by AERO DIGEST to the advertisers for answer. Allow at least a week for your reply.

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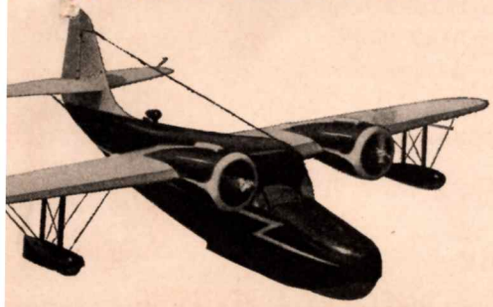

Remember how those words set your blood a-tingle when you were a kid?

Now that you're flying—recapture that thrill! *Don't* let weather keep you tethered to your airport. Get a panel of Kollsman Precision Aircraft Instruments, learn how to use them, and you *can* "go exploring."

For now the whole wide sky is yours to roam—instead of just the creek you knew at home. You can wander at will with the new Kollsman Direction Indicator. Its dial is just like that on your chart—so easy to follow.

Fill the thermos! Lock up the house! Where will you be at sundown? Over the horizon and far away. There's *adventure* ahead—with Kollsman!

Newport, Rhode Island, from an American Airlines Transport

☆ Kollsman production and research facilities today are devoted primarily to National Defense. For years Kollsman has been supplying Precision Aircraft Instruments to the United States Government Air Services, leading manufacturers and the major Airlines of the world. *Above:* a Kollsman-equipt Grumman G-21 Amphibian.

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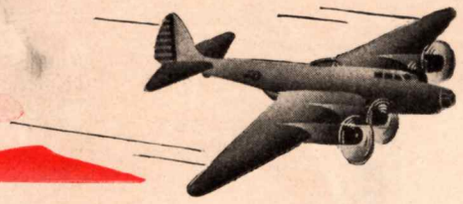
We assure the U. S. Aviation Industry that every effort is being made to accelerate development and production of Pesco finer aircraft products for the defense of our Nation—its heritage, its wealth, its democratic ideals, and its freedom.



The United States Army, Navy, Marine and Coast Guard rely on PESCO aircraft products for outstanding performance.

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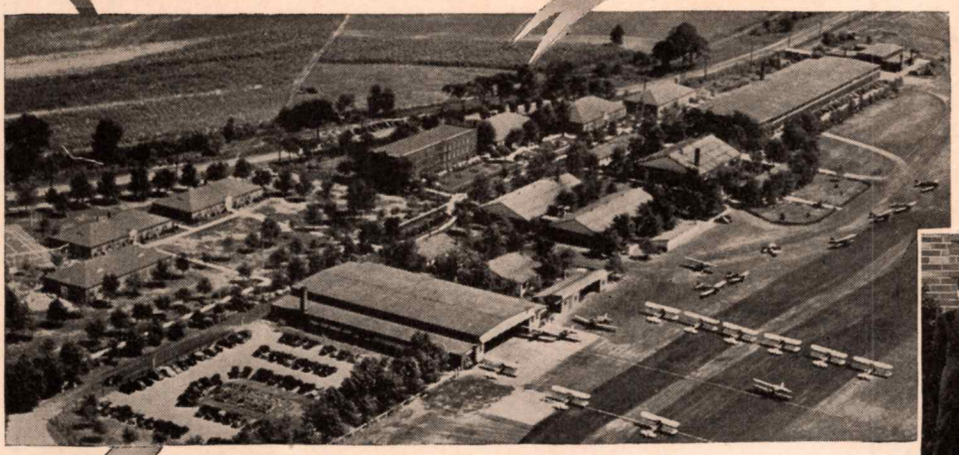
PESCO

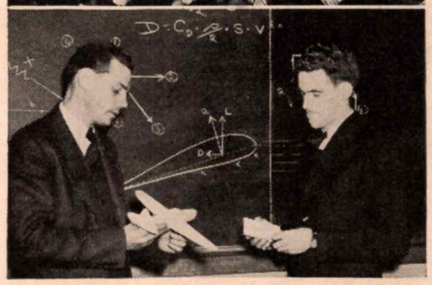
PUMP ENGINEERING SERVICE CORPORATION

DIVISION BORG-WARNER CORPORATION ★ 12910 TAFT AVENUE ★ CLEVELAND, OHIO

When You Choose Your Aviation School Select the One That TRAINS FOR LEADERSHIP in Commercial Aviation



At Left — *Aerial view of Parks Air College.*
Below — *"This is to tell you how pleased we are with the uniformily high results of the tests of your engineering group. It was about the best group we have ever tested." So wrote the Personnel Director of an aircraft factory, which maintains a staff of over 600 engineers, after giving tests to 14 of this group of 1940 Fall term Parks Aeronautical Engineering graduates.*
At Bottom — *Parks Air College teaches you the* WHY *as well as the* HOW.



You take a long step towards assuring your future success when you select the school that prepares you for a career, not just a job, in commercial aviation.

Therefore, you should acquaint yourself thoroughly with the advantages offered by Parks Air College—the school that has enjoyed Department of Commerce approval longer than any other in the United States.

Adhering to full college standards, Parks offers you thorough training in necessary technical skills. But that is not all. In addition, Parks gives you a comprehensive grounding in *basic principles* in your particular field of aviation.

At Parks you develop your capacity for independent, original thinking, a prime requisite for advancement. You learn to think problems through to the solution. You become familiar with the WHY as well as the HOW. You prepare for a career, not just a job.

With such a background, specialized in your field, yet broadly comprehensive, you can rise to leadership; you can win the increased recognition and remuneration that are the result of advancement to positions of large responsibility in the industry.

Determine *now* to select training that will equip you for steady progress. The records of hundreds of Parks graduates in commercial aviation, who today are in positions of leadership, are proof of the value to you of Parks standards and methods of education.

If your mind is set on success, you must match the quality of your training to your life plan. You're invited to send for complete information on the training opportunities offered by Parks Air College. The 64-page catalog, including full details, will be sent upon request.

PARKS AIR COLLEGE was founded August 1, 1927.
Has enjoyed Federal approval longer than any other aviation school.
Is accredited in its Aeronautical Engineering School by the Illinois Superintendent of Public Instruction.
Is accredited by the United States Office of Education of the Federal Security Agency.
Graduates are qualified educationally for appointment as flying cadets in the U. S. Army Air Corps and for flight training in the U. S. Naval Air Reserve.
Has a capacity enrollment of 300 commercial aviation students, 216 U. S. Army Air Corps flying cadets and 48 enlisted mechanics.
Has its own airport with a school plant of 25 buildings devoted to school purposes entirely, also two fields of 568 acres and 96 acres for military flight training.
Has a faculty of 82, each especially qualified for his particular field of instruction.

PARKS AIR COLLEGE — Section AD-4
East St. Louis, Illinois

Please send me details of four major courses in commercial aviation training.

Name.....Age....

Address.....

City:.....

State.....

PARKS AIR COLLEGE East St. Louis, Illinois

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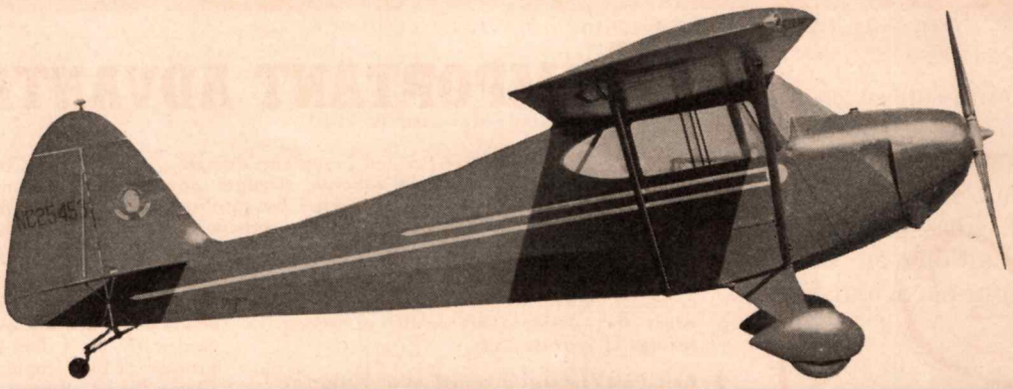
RUGGEDNESS ★ SAFETY

ECONOMY ★ STYLE ★ DEPENDABILITY

Superior performance is easy to say; but PORTERFIELD can prove this statement because, as always, PORTERFIELD Airplanes are leaders in their field from the standpoint of appearance, performance and economy. Incorporating smooth lines and a superb finish, PORTERFIELD Airplanes offer real pride of ownership for the sportsman pilot as well as for the fixed base operator.

PORTERFIELD tandem trainers are doing their bit towards helping National Defense by flying thousands of miles daily on C.P.T. instruction, turning out pilots whose transition work from PORTERFIELD trainers to secondary trainers will be much simplified—because the PORTERFIELD flies like a big airplane. The PORTERFIELD club plan offers an opportunity for economical flying, coupled with pride of ownership, and is worth investigating. Contact us at once, so that the PORTERFIELD representative in your area may demonstrate to you.

Our distributor organization has grown by leaps and bounds, but there are a few excellent territories still available.



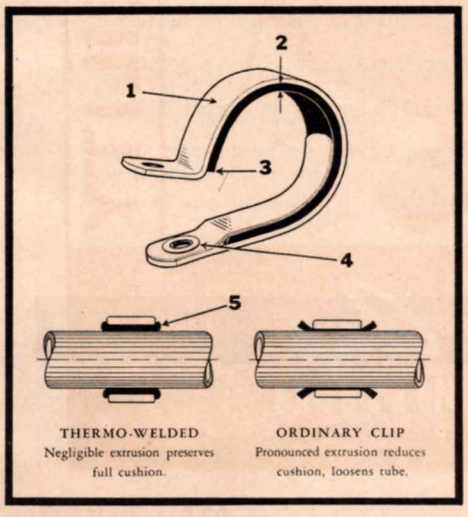
Porterfield Aircraft Corp.

2809 East 14th ST. KANSAS CITY, MISSOURI

THE NEW BENDIX CUSHION BONDED CLAMPS

THERMO-WELDED

5 IMPORTANT ADVANTAGES



Bendix of Burbank has bonded Neoprene directly to the Alclad Clamp by an exclusive thermo-welding process—with an adhesive strength greater than the tensile strength of the Neoprene itself. This bond is not affected by gasoline, oil, hydraulic fluid, or by extreme operating temperatures. This exclusive development offers you five outstanding advantages:

1 *Less Weight.* The Neoprene is on the inner surface *only* of the Cushion Clamp—all unnecessary Neoprene is eliminated from the edges and outside. This results in weight savings of at least 25%.

2 *Less Fire Hazard.* Elimination of Neoprene from all surfaces except on the "cushion" side reduces by 60% the area of Neoprene exposed to combustion.

3 *Quicker Assembly.* Bendix Cushion-Clamps are easier and faster to install, particularly in hard-to-get-at locations. As the Neoprene cannot creep or roll out of place, assembly difficulties heretofore experienced are entirely eliminated.

4 *Permanent Conductivity* is obtained by riveting the bonding strip to the Clamp with an integral upset eyelet. This Bendix method of bonding is superior both mechanically and electrically, as it does not depend upon the pressure of the Neoprene cushion against the Clamp for its effectiveness.

5 *Permanent Tightness.* Because the cushion is bonded to the Clamp, the Neoprene cannot extrude out under pressure. The possibility of the tube becoming loose in the Clamp is thus eliminated.

New Bendix Cushion-Clamps are in production and are available in all sizes from 1/8" up. Patents applied for.

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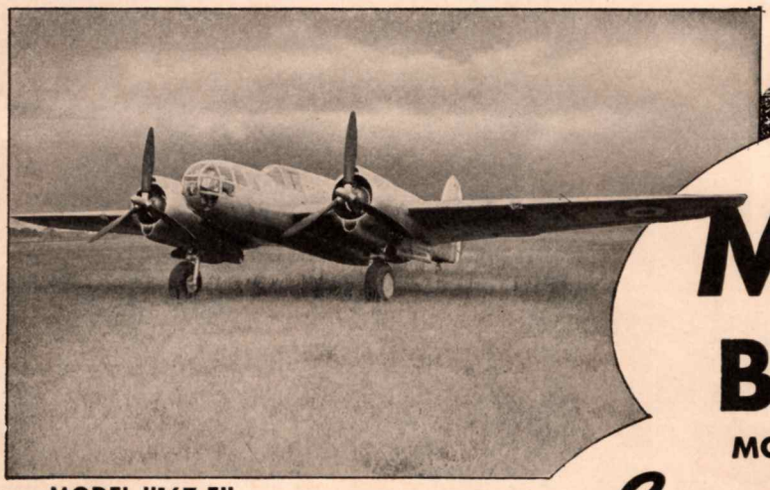

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MARTIN BOMBERS

MODELS "167-F" AND "PBM-1"

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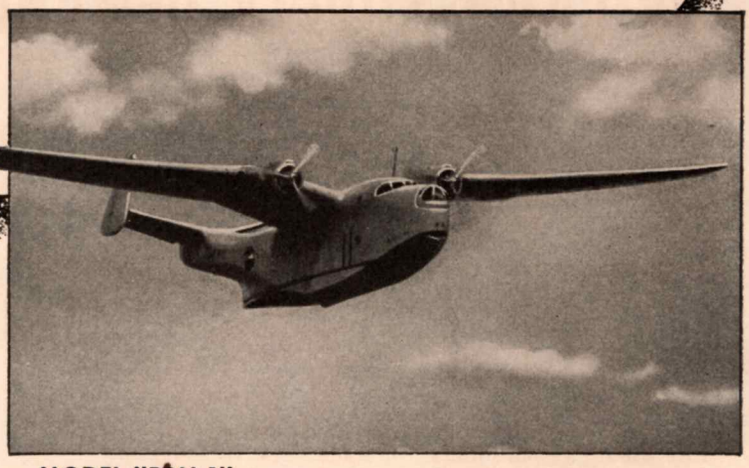

MODEL "PBM-1"

Throughout the control systems of the fast military planes here pictured (built by the Glenn L. Martin Co., Baltimore, Md.) and in the Pratt and Whitney Engines which power them, NORMA-HOFFMANN PRECISION BEARINGS are used. The "167-F" All-Purpose Attack Bomber has given notably successful service on European war fronts; and the "PBM-1" Long-Range Patrol Bomber is used in large numbers by the U. S. Navy.

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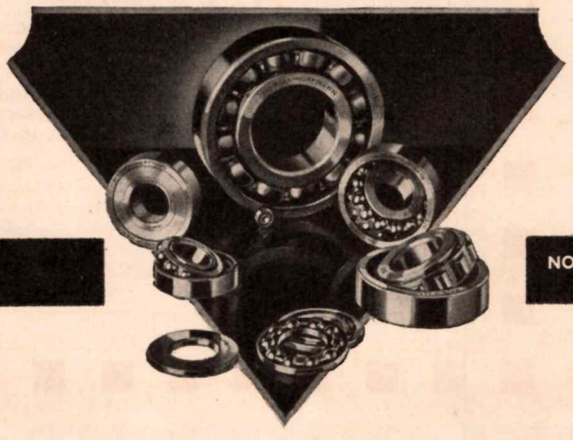

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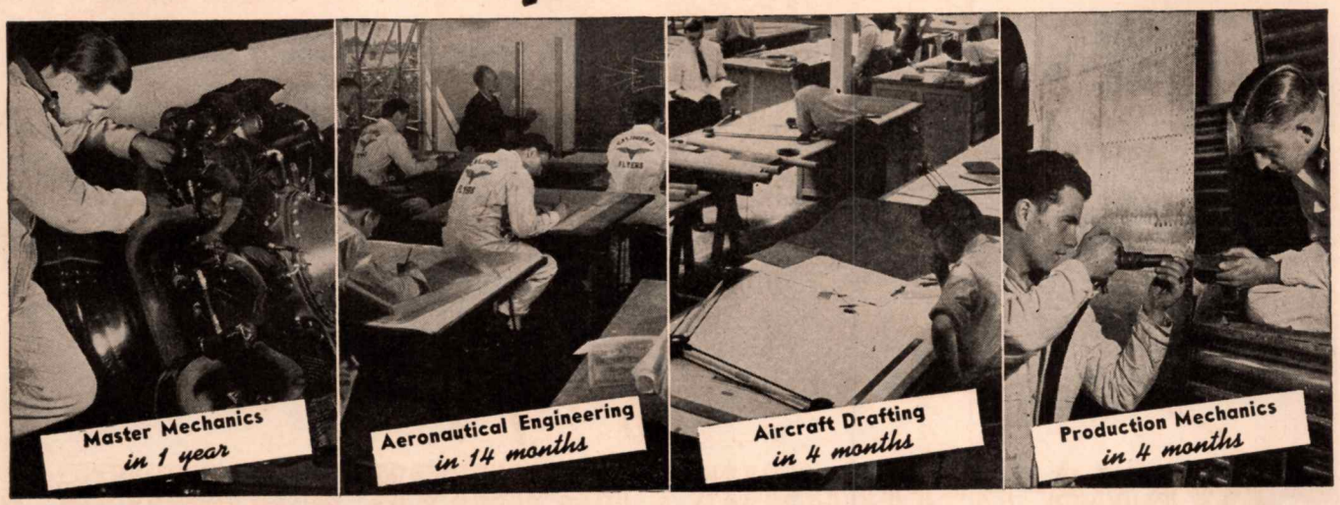
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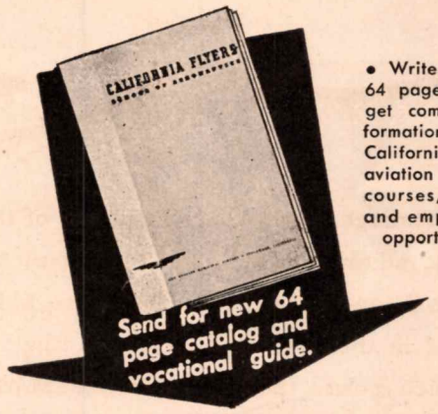

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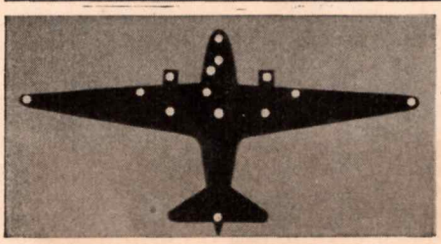

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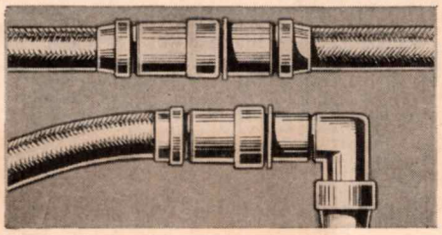

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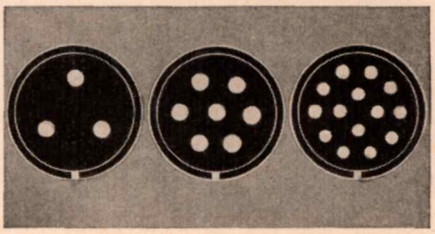

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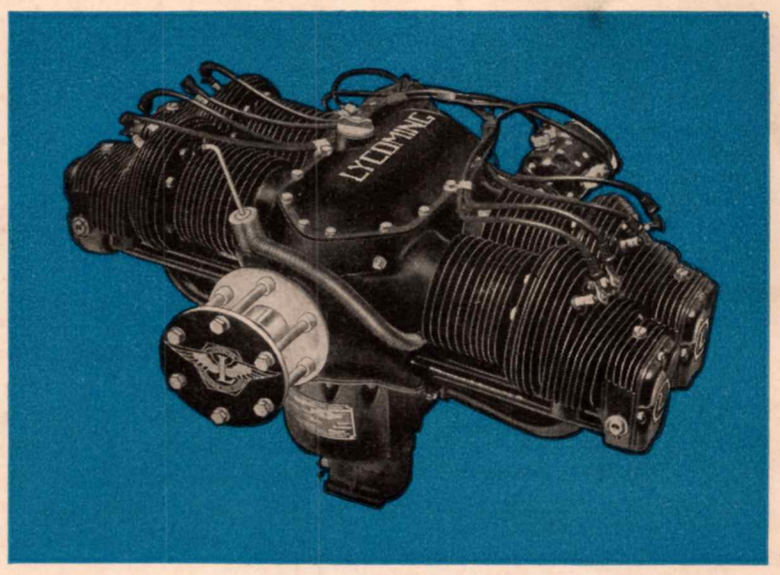

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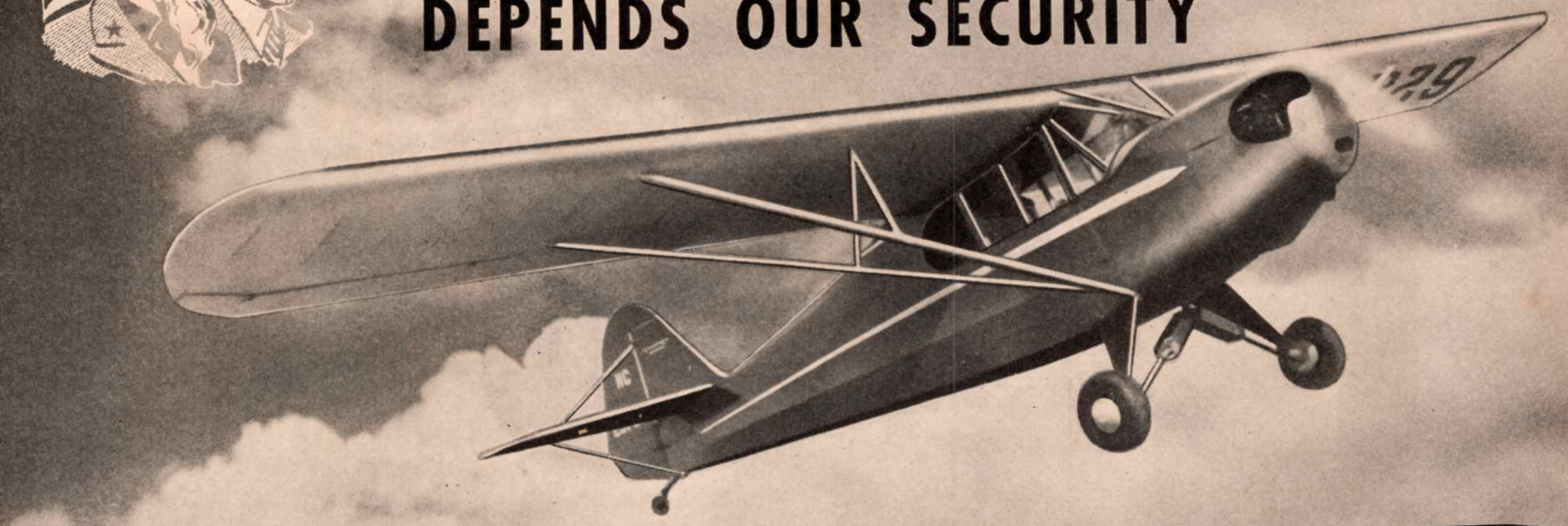

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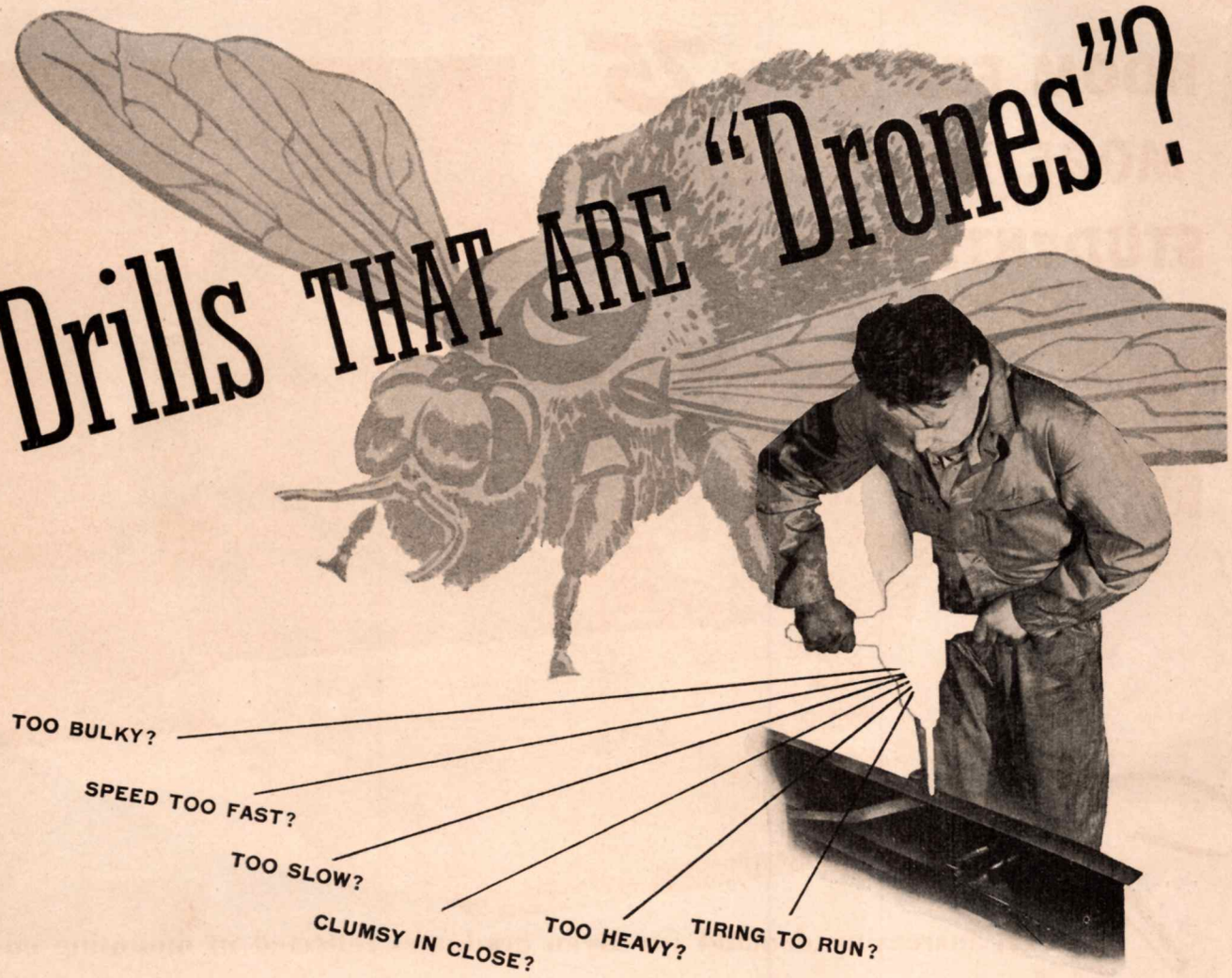

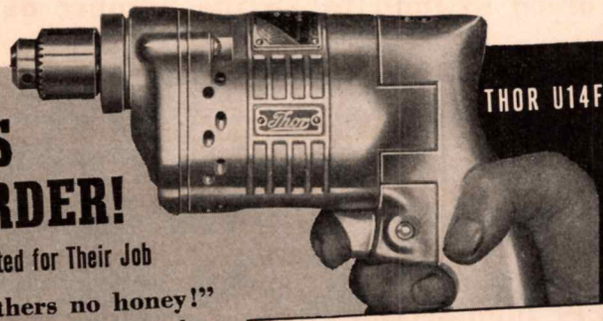

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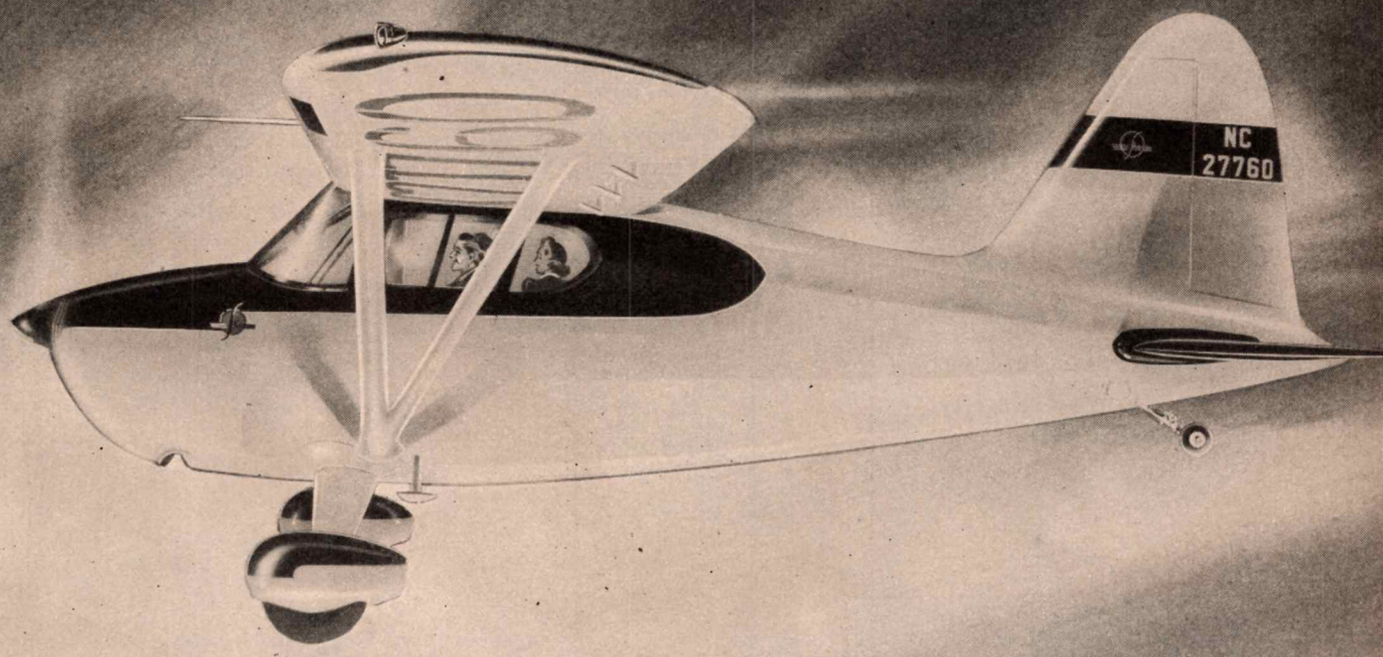

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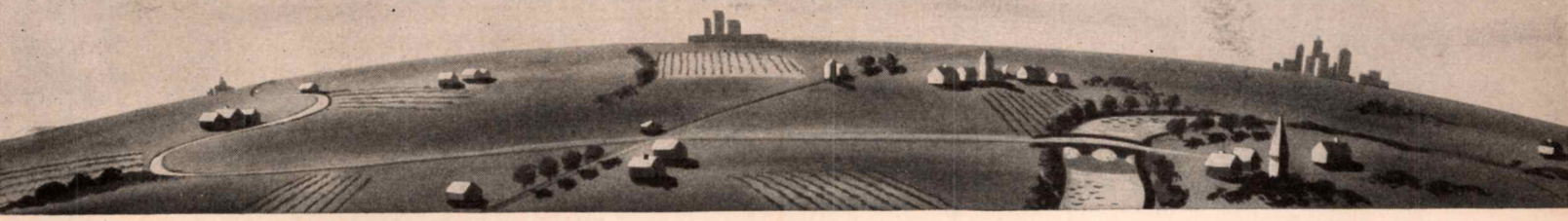

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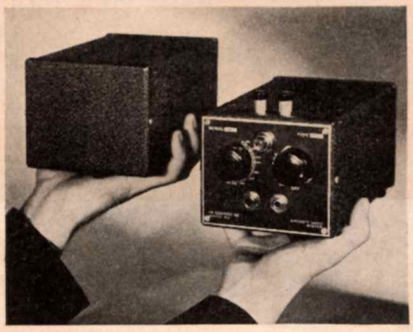

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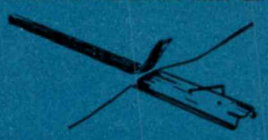

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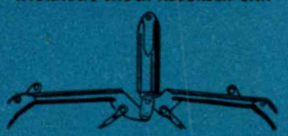

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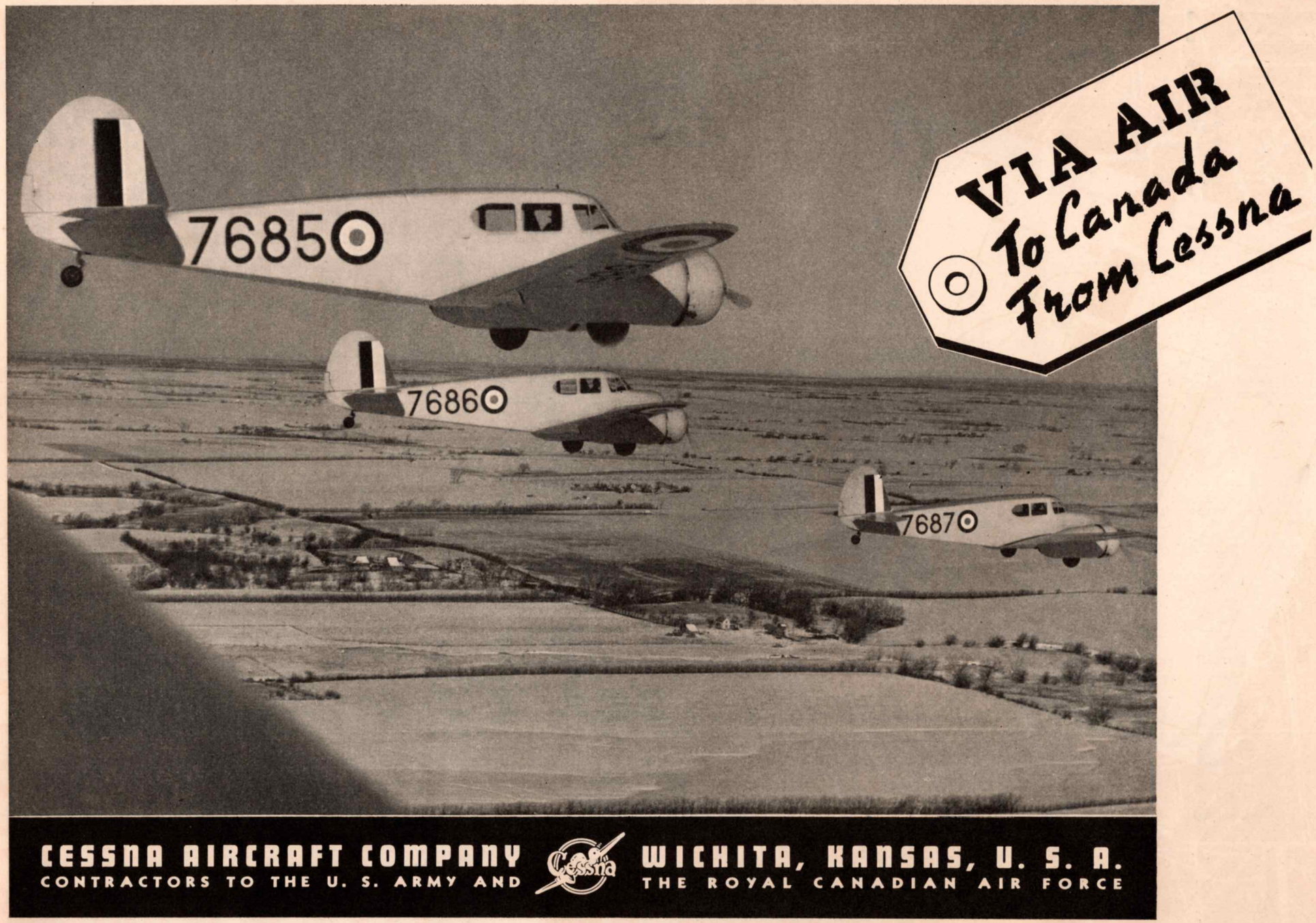
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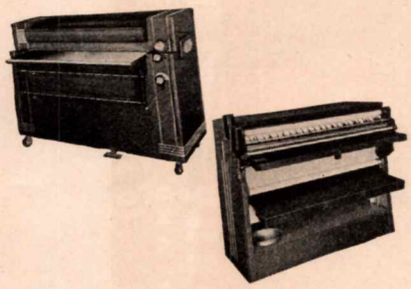

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Prints up to 42" in width, any length, can be handled.

The Bruning booklet, "New Light On Prints," fully describes the "75" Printer and the Model 154 Developer, and gives information about other Bruning printers and developers. Send for your copy.

YOU take the shortest possible time between plan and product when you use Bruning BW (black line) Prints, instead of blue prints.

The reasons are simple. BW Prints are produced in *seconds*—rather than the minutes that blue prints require. BW Prints require *two* simple steps—exposure and development—while blue prints require five. BW Prints need no washing and drying. BW Prints permit big volume production of prints cut to the exact size of your tracings—no unrolling and cutting of roll stock to get the prints you want. No wonder BW Prints smooth out "kinks" in production all along the line!

Bruning representatives have facts and figures to show you why you can save time—and money—with Bruning Black and White Prints. For faster production, get in touch with one soon—and mail the coupon now for complete information about BW.

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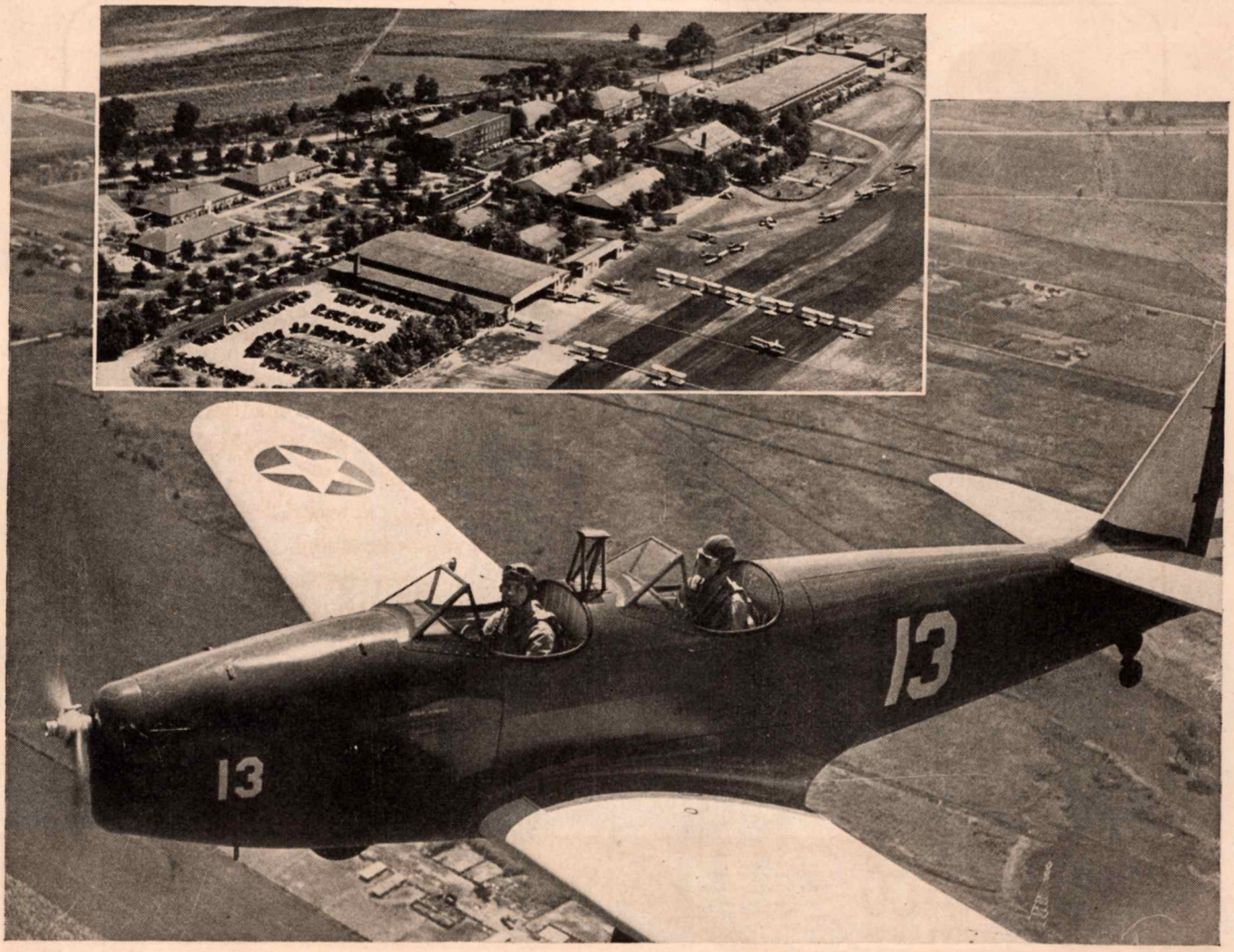

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If you fulfill initial qualifications, you will be placed on a salary and provided, free of tuition charges, with a standardizing course of flight training which takes about three weeks. Immediately on passing final checks given by an officer of the Air Corps, you will start your work as a regular Instructor, with a substantial increase in salary.

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Waco trainers are built to "take a beating" . . . built to do a lot of hard work with a minimum of maintenance . . . built to assure the operator a profit on his operation . . . that's why so many operators choose Wacos for the CPTP secondary training.

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In its all-out race against time, America must have instant, accurate, unfailing communications. Telephone, cable, radio, air mail—all are absolutely essential. And yet, in days when international destinies are shifting with each passing hour, these alone are not enough.

The ability of some one in Washington today, to meet some one in Europe tomorrow, is a vital necessity.

To bring Europe and the United States *precious hours* closer together, American Export Airlines is rushing the completion of great, four-engined flying boats. These giant planes will inaugurate the first non-stop transatlantic, commercial flying service — eliminating intermediate stops, thereby insuring dependable, regular, time-saving crossings.

These ships are being built by Vought-Sikorsky Aircraft, Division of the United Aircraft Corporation, at Stratford, Connecticut, under the personal supervision of Igor Sikorsky, internationally famous aviation figure.

Mr. Sikorsky says:

"I firmly believe that this fleet of huge transoceanic flying boats represents the latest word in air transports. They combine long flying range with high operating speed. They will carry an outstanding pay-load non-stop across the Atlantic. They will have living and sleeping quarters, for passengers and crew, that have not been equaled in any land or sea plane.

"These ships, with full pay-load of passengers, luggage, mail and all necessary equipment, will be able to cross the Atlantic non-stop—and will maintain this non-stop service between the United States and Europe. The elimination of intermediate landings will greatly contribute to the regularity and speed of the service, because the ships will be freed from delays caused by weather and other circumstances incidental to intermediate stops.

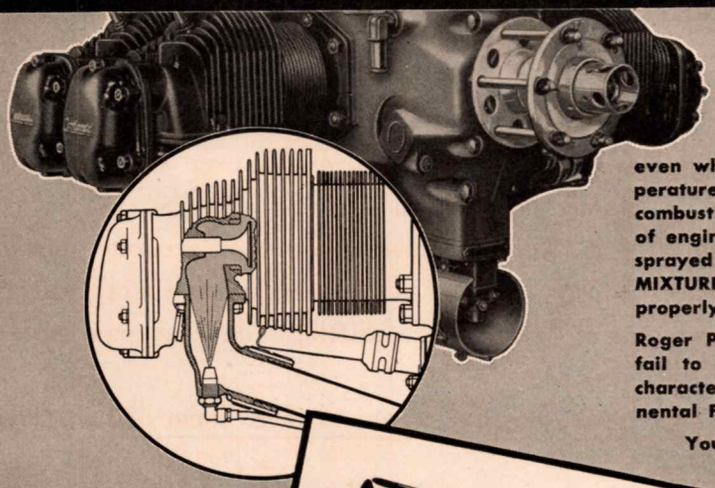
"I am convinced that these fast, flying boats, which we are building, will open a new page in the history of travel between America and Europe."

To help this nation meet the emergency of this hour . . . to place into the Atlantic air lanes a service that will help build this nation in the greater commerce of a peaceful tomorrow . . . these are the objectives of American Export Airlines.

American Export Airlines, Inc.

25 BROADWAY, NEW YORK CITY

GET ALL THE FACTS *about* FUEL INJECTION



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even when flying in areas of high humidity and low temperature, because fuel vaporizing takes place at the combustion heated intake ports. Neither is there any chance of engine failure due to water in fuel system. It is simply sprayed into cylinder head and consumed. ATMOSPHERIC MIXTURE CONTROL — Any part throttle of fuel and air is properly proportioned in all flying altitudes.

Roger Parrott of Parrott Flying Service says, "You never fail to recognize that smooth, reliable husky throb so characteristic of Continental Red Seal Engines with Continental Fuel Injection."

You can have this Extra Safety — Extra Power — Extra Economy and Extra Smoothness by specifying Continental Fuel Injection. Insist on it.

. . . READ what George Wedekind has to say about Fuel Injection

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November 2, 1940

Continental Motors Corporation
Aircraft Engine Division
Muskegon, Michigan

...sh to acknowledge the receipt of the new 65 Contine...
...which we ordered from you on October 18, to be used in conjun...
...th the five ships that we are operating at the present time in our scho...

We wish to say that we are pleased with the Continental motors equipped with fuel injectors. We certainly do not want to go back to the carburetor motors. Any new equipment we buy must be equipped with fuel injectors. Three of our fuel injection ships, which were purchased in 1940, have run up a total time between the three ships, of 1900 hours which has been on student instruction and Instructors' Refresher Course. We have never experienced any difficulty at all with the fuel injection system during this flying time.

We have just purchased two more Luscombes equipped with fuel injector engines, and have about 110 hours on each of these ships. We have run a total of ...proximately 2100 hours of flying time on fuel injector engines and ...tainly well pleased with them.

We are now ... to be checked. The nozzles have given new engine in one of the ... is the first overhauling on this ... nozzles to the Fuel Injector Corporation to be checked and put in first-class us no trouble whatsoever. However, due to the fact that we are overhauling the motor, we feel that these nozzles should be checked and put in first-class condition so that we may be able to secure another 700 hours of uninterrupted service.

If any one has any doubt in regards to the purchase of an engine equipped with fuel injectors, please have him write us. We will be glad to tell him of our experience. We have operated our ships in all kinds of weather and have never experienced any difficulty such as icing as we have with a carburetor motor.

Yours very truly,

QUEEN CITY FLYING SERVICE, INC.

George J. Wedekind

George J. Wedekind, Vice-President

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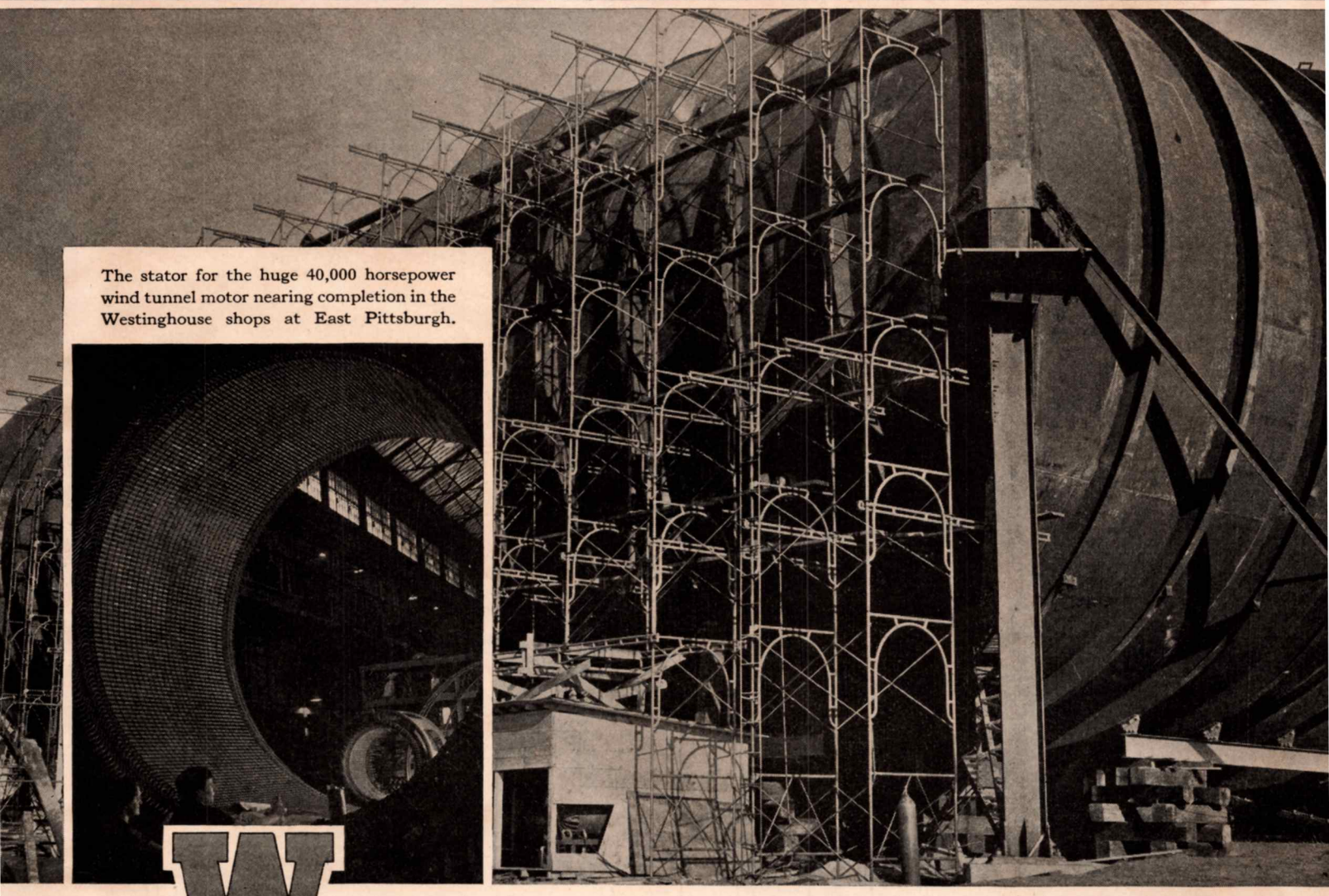

The stator for the huge 40,000 horsepower wind tunnel motor nearing completion in the Westinghouse shops at East Pittsburgh.

World's largest motor powers Army wind tunnel fan

Man-made hurricanes of 400 miles per hour in the new Army wind tunnel, Dayton, Ohio, will facilitate airplane tests. Westinghouse is now completing the world's largest wound-rotor motor for this wind tunnel—a 40,000 horsepower motor that will drive two 40-foot fans. Speed can be varied from 37 to 297 revolutions per minute. Nearly two stories high, the motor will require 85,000 cubic feet of air per minute to cool it when operating at top speed.

Construction of this huge motor is evidence of Westinghouse Engineers' ability to build equipment that meets the exacting needs of the aviation industry. You will find Westinghouse developments in every phase of the industry—precision motors and control for parts manufacturers, complete airport lighting, radio range equipment, instruments, and scores of others.

Westinghouse offers you the latest developments in electrical equipment. You'll find it worth-while to call our local office for every electrical need.

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Capable of unbelievable speed and bomb loads, the FB-1 is also heavily armed for defensive operations.

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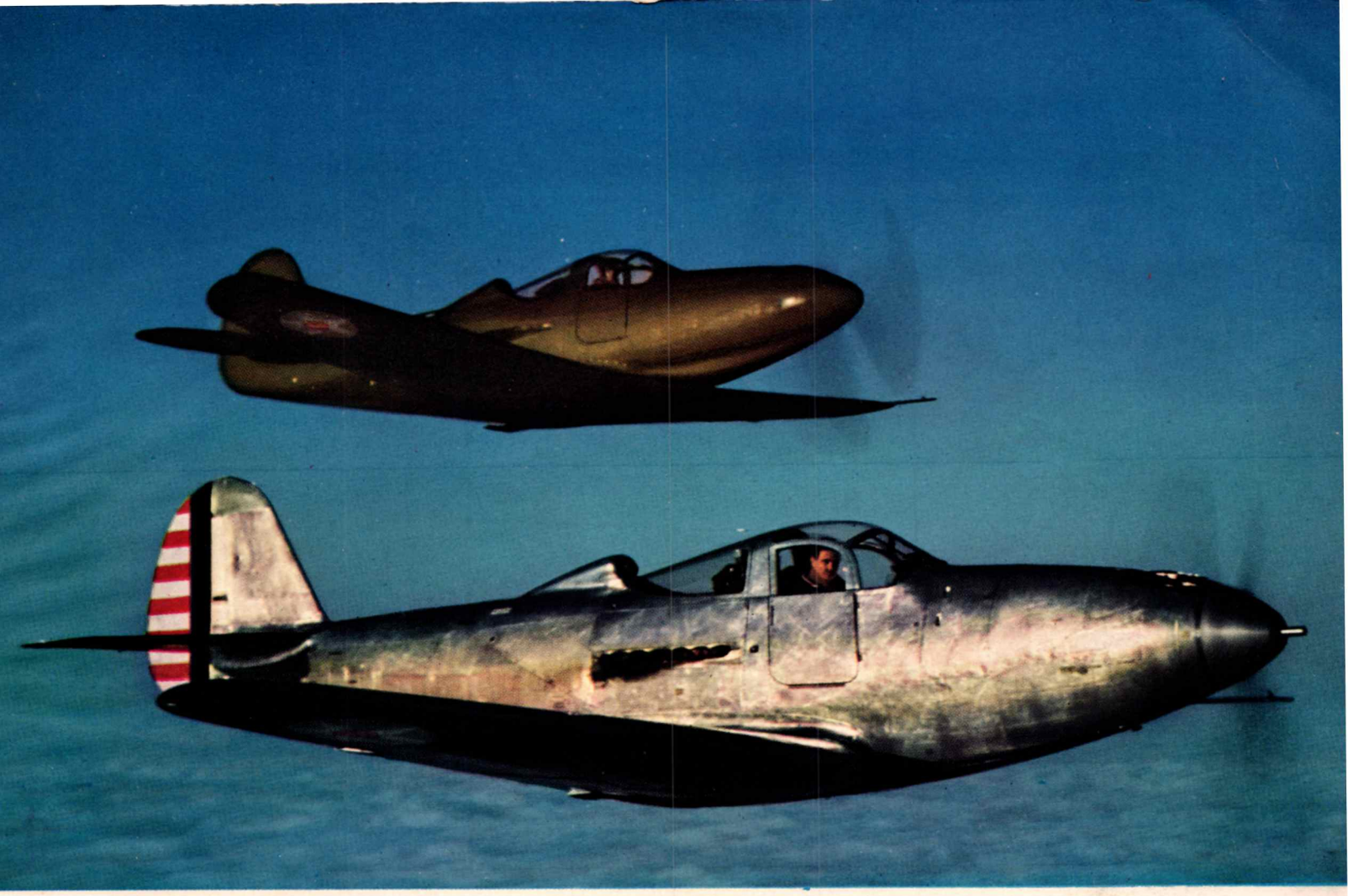

Spearheads of Defense

SWIFT in action, deadly as its namesake, the Bell Airacobra, with an aircraft cannon firing through the hub of a specially designed Curtiss Electric Propeller, is an effective new weapon of defense.

Designed for high performance and maneuverability, the P-39 adds new fighting power to the U. S. Army Air Corps and the Royal Air Force.

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Curtiss-Wright Corporation • CALDWELL, NEW JERSEY

Bell P-39 for Army Air Corps

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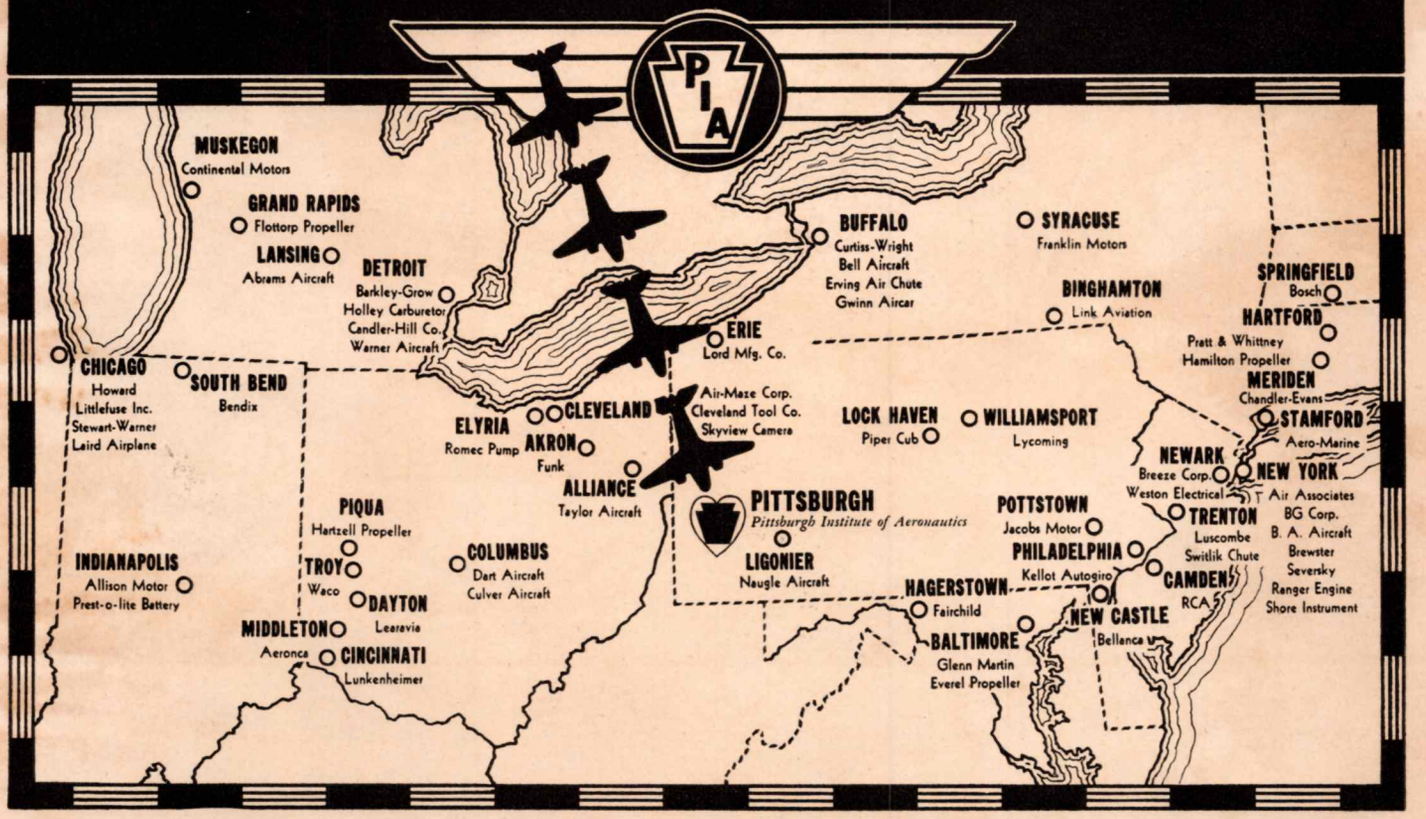
*The Thundering Herd**

Brewster

*BREWSTER BUFFALOS ON DUTY WITH THE R.A.F.

FIGHTERS AND DIVE BOMBERS ★ *for Lasting Mastery of the Air*

Study
IN THE HEART OF AMERICA'S AVIATION INDUSTRY



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Preparedness is the keynote of America's fastest-growing industry—Aviation. Are you prepared to take your place in this fascinating and high-paying field? Hundreds of P. I. A. trained men are now employed in key positions throughout this ever-expanding industry. Many are well on their way to financial independence and success.

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Over 3,000,000 passengers have flown on American Airlines' Flagships with safety. In making this record, the Flagships have operated over 92,000,000 airplane miles, *lubricated exclusively with Sinclair Pennsylvania Motor Oil.*

These facts are more compelling than words in describing the high quality and reliable performance of Sinclair Pennsylvania.

For further information about this motor oil and other specialized Sinclair lubricants for the aviation industry, write the nearest Sinclair office. If you would like lubricating engineering counsel, write Sinclair Refining Company, 630 Fifth Avenue, New York, N.Y.

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BENDIX RADIO

BENDIX RADIO NEWS

APRIL 1941 | Published by BENDIX RADIO CORPORATION, Baltimore, Md. | Cable Address BENRAD

WESTERN AIR EXPRESS, CONTINENTAL ORDER BENDIX AUTOMATIC COMPASSES

10 AIRLINES Have Standardize n MN-31 COMPASS UNITS

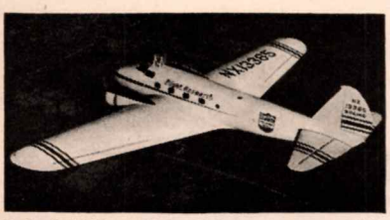
Recent orders for Bendix MN-31 Automatic Radio Compasses by Western Air Express, Continental Airlines and Catalina Air Transport have increased the list of commercial airlines using this modern navigational aid to a total of 10 in all. The rapidly increasing list of users is abundant proof that Bendix Automatics meet the rigid requirements of scheduled airline operations.

Western Air Express has ordered Bendix MN-31 Automatic Radio Compasses and RTA-1 Communication Units (Transmitter-Receivers, ARINC SPEC. 508A). This combination provides complete communication and navigational Radio facilities with minimum weight and maximum efficiency.

Continental Air Lines are installing Bendix MN-31 Automatic Radio Compasses on their entire fleet of Lodestars. Thoroughly tested under actual operating conditions, the Bendix MN-31 simplifies air navigation by providing continuous corrected bearings without attention by the pilot or navigator.

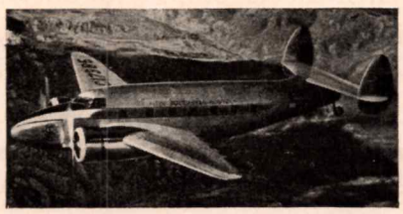
Catalina Air Transport has just placed orders to equip its ships with Bendix Automatic Radio Compasses.

Pan-American have installed Bendix MN-31 compasses on all Trans-Atlantic Clippers. This was the result of a test of 1,000 hours of service without failure on the Dixie Clipper.

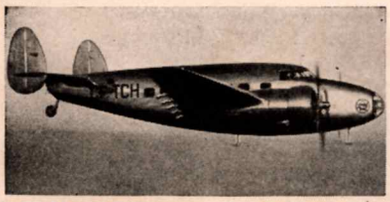


United Airlines flying laboratory on which the Bendix MN-31 Automatic Compass received exhaustive tests before being adapted by United for installation on its entire fleet.

Penn-Central is equipping its famous Capitol Fleet with MN-31's. In addition, Penn-Central's ground stations (shown here) are equipped with Bendix Transmitters and Receivers.



National Airlines has equipped all of its new Lodestars with the Bendix MN-31 Automatic Compass. In addition, they have Bendix RTA-1 Communication Units. (ARINC SPEC. 508A.)



Trans-Canada, after testing MN-31 Compasses over its western Canadian routes, where long-range Radio operation is a "must," standardized on Bendix MN-31 Automatic Compasses.

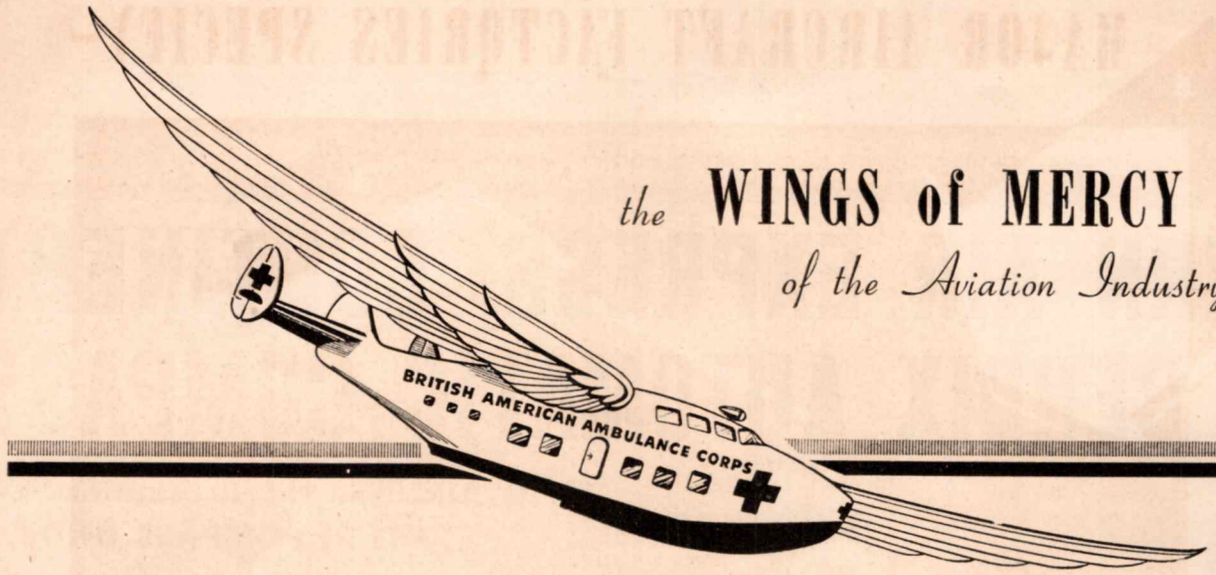
Northwest Airlines have used MN-31's almost since the introduction of this Compass. Shown here, the Loop of the Automatic Compass installed on the belly of a Northwest Airliner.

Delta Air Lines, one of the oldest lines in the country, has equipped its new Douglas Transports with Bendix MN-31 Automatic Compass units, and Bendix RTA-1 Communication Units.

PAN-AMERICAN GRACE

Installs BENDIX TRANSMITTERS on Entire Fleet

The 100% acceptance of the Bendix TA-2 Transmitter for Pan-American Grace Airliners, flying over the rough terrain of Western, Central, South America where Radio Communication is exceptionally difficult due to tropical conditions, is strong proof of the amazing reliability and ruggedness of this famous 8-channel, 100-watt Unit.



the WINGS of MERCY *Committee of the Aviation Industry*

ANNOUNCES the opening of its drive for Ambulance Planes, with which to save the lives of R. A. F. pilots.

The Royal Air Force, fighting largely over water, does not possess adequate aerial rescue equipment. When an R. A. F. plane is shot down—or forced down—at sea, the survival of its crew is doubtful. These boys deserve a better chance to live—for their own sakes, and their families'. England and Democracy need them back in the air more than ever before.

We in aviation know the value of trained military pilots; we know how long it takes to train them, and how costly the training. We realize the significance, too, of a silent motor or a crippled plane over a wide stretch of sea. Thus we should appreciate more keenly than anyone else the importance —and the urgency—of providing flying ambulances for the R. A. F.

Lord Beaverbrook advises that these ambulance planes "will meet the most pressing need, extending heartfelt thanks for any assistance in this hour of trial." The *Wings of Mercy* Committee needs your help and influence to put across this war-wise and humanitarian project, and to put it across *fast*. We know you have the desire to help, for lives—courageous, young, necessary lives—are being lost every day. Some of these lives need not be lost.

We urge everyone in the industry to support this drive, for "never . . . was so much owed by so many to so few."

The Wings of Mercy Committee · FRANK A. TICHENOR, *Chairman* · W. R. CASTLE · MAJOR REED CHAMBERS · DONALD W. DOUGLAS · SHERMAN M. FAIRCHILD · R. H. FLEISCHMANN · RICHARD GOLDSMITH · ROBERT J. GROSS · CASEY JONES · COL. JOHN H. JOUETT · GROVER LOENING · LAUREN D. LYMAN · GEO. F. MCLAUGHLIN · THOMAS A. MORGAN · EARL D. OSBORN · CAPT. E. V. RICKENBACKER · J. EARL SCHAEFER · JOHN M. SCHIFF · FRANK A. VANDERLIP, JR. · JOHN B. WALKER · RODMAN WANAMAKER · SIR WILLIAM WISEMAN · MAJOR GILL ROBB WILSON · H. E. MORDAN

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Fletcher trained men have what it takes to get and hold the work they are given to do. Two thousand four hundred Fletcher trained men have gone to work in the last 12 months—most of them assigned to special positions in the Experimental, Final Assembly and Tooling departments of major factories.

Yet today we are called on for many times the number of trained students available. Because of this situation, you should act at once if you are seriously interested in building a secure future for yourself in aviation. Before you enroll Fletcher gives you factory approved aptitude tests to make certain that you can put this training to gainful use. Convenient Bank of America terms are available. The coupon will bring you complete information. Send it Airmail TODAY.

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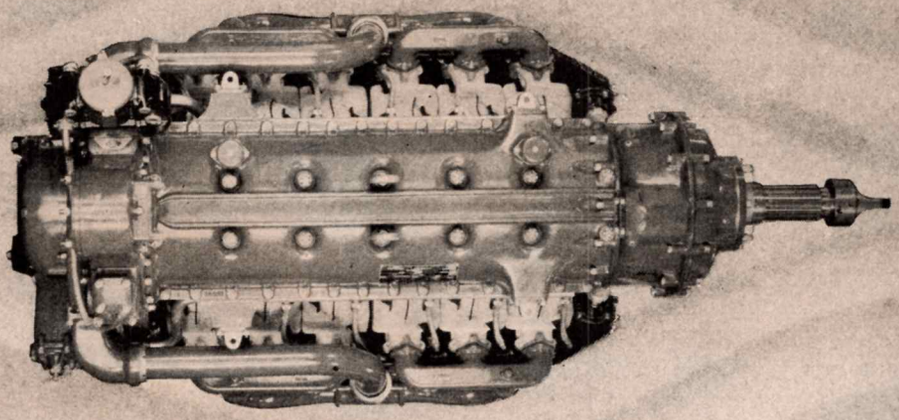

Now in the Navy—the "V" in-line, air-cooled, highly supercharged 12 cylinder Ranger engine. No other powerplant produces equivalent horsepower from such low weight and small frontal area. The Ranger engine offers both air-cooling and splendid opportunity for closely cowled streamlined design.

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EDITORIALS

"There's doubt in people's minds as to whether we could produce a sufficient number of man-hours in America to absorb orders for $7,000,000,000 worth of equipment in the next two years; but we have such extensive reserve supplies to draw from and such great experience behind us, it is only the learning and tooling that we have to go through. Once we surmount that we can make twice as much as anybody else can make. I have seen and even operated plants in the countries over there; and when it comes to getting tooled up — after we do that over here you won't have to be concerned about the output."

—Wm. S. Knudsen, Defense Production Director

Too Many Cooks— Too Few Mechanics

During the last war it seemed to be standard Army procedure to enlist mechanics and barbers, give them a six-weeks' cooking course, and turn them loose on the hapless soldiery as cooks. Those who were cooks in civilian life, naturally were transformed into barbers or mechanics. Thus the Army rejoiced in the services of some of the world's worst cooks, mechanics, and barbers.

This time, we were told, it would be different—no more would Army slum be stirred by a cook with a monkey wrench in his hand and a hatred of cooking in his heart. Men would be set to do what they were best fitted to do. However, it would appear that the Army's sensible plan is being defeated by the local draft boards.

Young men, now training at their own expense in commercial aviation schools, to become pilots or mechanics, are being drafted when their numbers come up. Some are granted 60 or 90 days' deferment by local draft boards, or enough time to complete their courses and graduate from the schools. Others are not so fortunate.

For instance, at the Casey Jones School of Aeronautics in Newark where there are 995 civilian students, 20 already have been drafted; at the Academy of Aeronautics at LaGuardia Field, where there are 400 students, 16 have been drafted. Of the 57 men at both schools who have received draft numbers, 20 have been inducted; 5 are in Class 1A, 10 in 2A, 11 in 1D, 2 in 1E, and 9 still are to be interviewed. Aviation students are taken into the Army with their training uncompleted. They may be sent to the infantry, artillery, or even the Air Corps—in which event they will be given training that they were already taking at their own expense. There is no system, no rhyme or reason to the procedure of local draft boards—despite the fact that Washington recently told them to use discretion. They use it—but each draft board evidently uses a different brand of discretion.

The point here is not that a young man's education is being interrupted. It is that these young men were training for the jobs for which the Army will need thousands of them—by 1942 it is believed the Army will need from 135,000 to 150,000 pilots alone. Such a program would call for 800,000 mechanics and air crew members —and at least double the number of trained men now working in the aviation industry.

Draft boards must realize — and Washington must make them realize —that this war is not a simple matter of putting so many men into an Army, and then sorting them out, separating the mechanics from the cooks. It is, on the contrary, a matter of planning to put trained man-power where it may best serve the national defense—whether in the factory or on the flying field, or in the air.

This is a war of production of mechanical weapons, from guns and tanks and planes to warships. They cannot be used until they have been produced; and they cannot be produced by untrained men—after local draft boards have sent the trained men into the Army.

Furthermore, in this period of rapidly expanding production of material in the factory and of man-power in the Army, old-time definitions of what constitutes a "trained mechanic" must be jettisoned. A young man half trained to become a mechanic already has a certain value as a mechanic—why not complete the job, or let him complete the job in the commercial schools? If he fails to qualify, he still will be available for the draft, in any capacity where his services will be most valuable to the nation.

Civilian Training for Defense

Does anyone doubt that sooner or later we face the probability of war? And sooner, rather than later? True, a British victory over Germany would remove the present threat of war. But a German victory over Britain would find us either embroiled with the Axis powers or capitulating to their economic world of slave labor, an unthinkable position.

Congress is realistically facing the threat of armed conflict: it is appropriating billions for National Defense, billions more for aid to Britain, China, Greece, and other decent countries that find war thrust upon them by the gangster governments of Europe and Asia.

Yet in the matter of training pilots for national defense, Congress evidently is blind. It surely does not appreciate the immense value of the CAA Civilian Pilot Training Program, or the Director of the Budget would not pare the modest $43,000,000 requested for the next fiscal year to $18,000,000 which is less than half of the 1941 appropriation of $37,000,000. By what reasoning can Congress bring itself to believe that the production of pilots during the next fiscal year is of less vital importance than it was a year ago—when we were a year further away from war than we are now?

But perhaps the word "Civilian" in the Program has led Congress to believe that this training plan has little to do with National Defense. It is true that the students are civilians and are being trained as civilians. But every civilian of military age and physical fitness in this nation is subject to the draft—so civilians retain that status only until they are needed in the armed services. Thus the young civilian, given elementary or advanced flight training, goes into the Army with the preliminary flying experience that will form a sound basis for military flying.

The CPTP results in courses completed from February 1939, to January 1941 were: 37,277 graduated from

(Continued on page 97)

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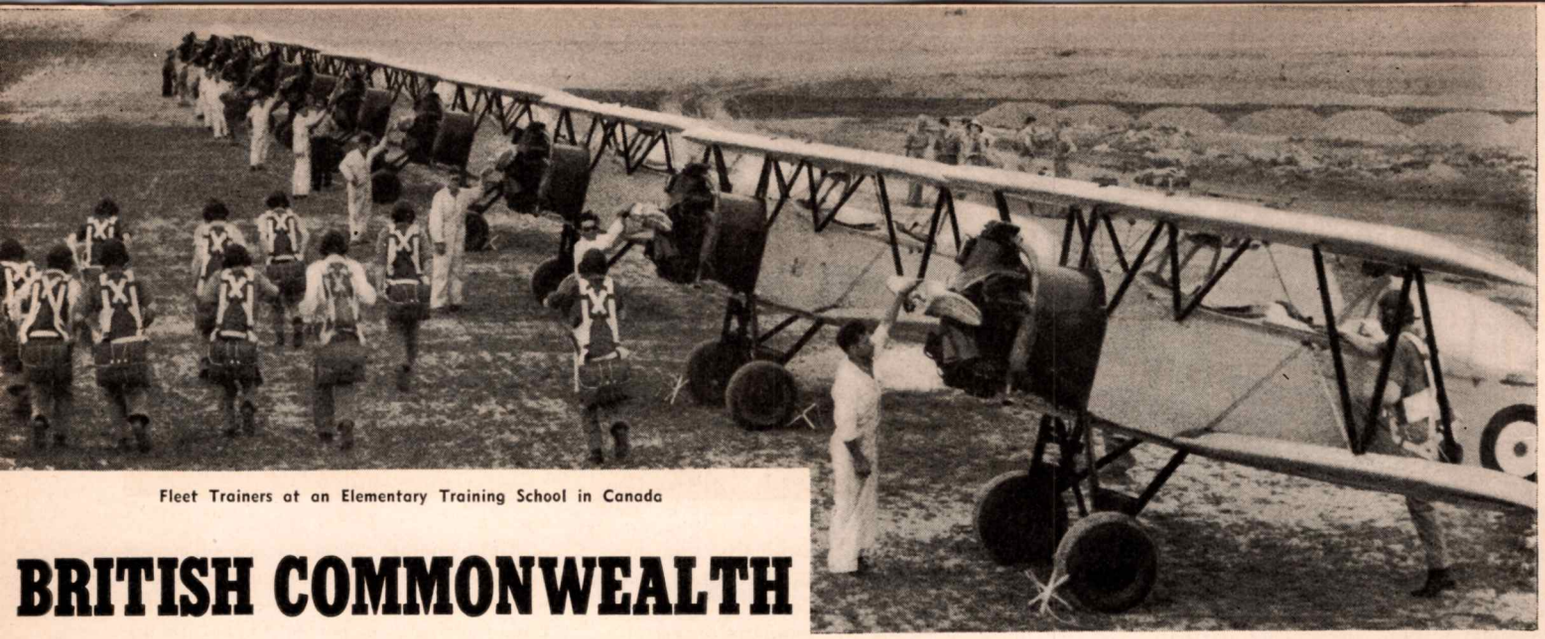


Fleet Trainers at an Elementary Training School in Canada

BRITISH COMMONWEALTH AIR TRAINING PLAN

CY CALDWELL

● Last month I went to Canada and visited three Royal Canadian Air Force training centers in Ontario. It was just a glimpse, but I got a good idea of what is going on all over the Dominion. And it's plenty.

I made the journey by Covered Wagon —an old Fairchild 51, vintage of '28 or thereabouts. As this noble flying machine, clothed in the hoary dignity of age, drifted slowly down to a landing on the Fleet Aircraft Corp. field at Fort Erie, I turned to Jack Sanderson, President of Fleet, with whom I had been visiting, and said, "I guess the Canadians must think that an old buck like me wants to fly low and slow."

When the 51 trundled up to the line and I respectfully took off my hat to it, a Flying Officer, a Flight Sergeant, and a Public Relations officer of the Department of National Defense stepped out to greet me. They explained that since all their more modern transports were ferrying important officials hither and yon, their transport division was temporarily reduced to this one indestructible relic of Sherman Fairchild's pioneering days (or daze) and would I forgive them for not having a snappy new Lockheed to place at my disposal? I said I was delighted to ride in the old 51, which had so grandly proved the wearing qualities of American airplanes.

We took off for Jarvis, Ontario, about 40 miles away—and got there in less than an hour. It turned out to be one of three Bombing & Gunnery Schools now in operation—there will be ten of them in the complete plan. Our next stop was at Mount Hope, an Elementary Flying Training School near Hamilton, one of 20 now in operation, of which there will be 26 in the total plan. We stayed overnight in Toronto and took off the next morning for Central Flying School at Trenton, where a strange piece of good luck befell me.

As we landed an odd-looking guy came up to the plane, examining us and it attentively. He might have been a Secret Service man, or a visiting Congressman, or even a German spy. But he seemed so interested in the old Fairchild that I thought I'd give him a little information. This, I told him, is the latest American dive-bomber. It is our answer to the Stuka—the Stuckah, or Stinkah. The Nazis would pay thousands of marks to learn of the existence of this remarkable warplane, I told him. Is it fast? he inquired. Terrific! I said. If we took off for Toronto this afternoon, we'd be there last week—unless we encountered head winds. He

Instructor in the cabin of an Avro "Anson" (left) and a typical group of students at one of the Elementary Training centers of the Royal Canadian Air Force

North American "Yale" Trainer used by the RCFC for basic training

seemed greatly impressed.

Well, after visiting Trenton, we started to warm up the 51 for our return crawl through the air, when a Flight Sergeant came up and announced he'd made a discovery. There was a large hole in the rear end of the fuselage; he couldn't certify the noble craft as airworthy until it had been patched. We looked at the damage—it looked exactly as though some malicious person had kicked that hole in there. At first the Commanding Officer—who had been flying for the Canadian Air Board on Forest Patrols back in 1922, the same time that I was engaged on the same job—at first he seemed to wonder if I hadn't let my foot slip, hoping to trade in that 51 for a Lockheed 12. I'd been mentioning casually how refreshing it would be to fly back to Fort Erie and almost keep up with the trains going in the same direction. But I told him about this suspicious-looking character — either a German spy or an Isolationist U. S. Senator, from the looks of him—so I was exonerated—I hope. And as there wasn't time to patch the hole and still get a radio man back to Toronto in time for his broadcast, the Royal Canadian Air Force royally placed a Lockheed 12 bomber at our disposal, and we flew back to Toronto and Fort Erie in style —and comfort. I wonder if they ever caught that spy—or Senator.

All I saw of the training was a sample, but training centers resemble airplane factories and circuses. If you see one, you see them all, without wearing out your feet and your disposition. I had walked several miles visiting the Curtiss, Bell, and Fleet plants, and if I had inspected more than those three RCAF fields I'd have demanded an attendant with a wheel chair. I've always loathed exercise. Sometimes, when I notice I'm getting fatter, and feel that I really should walk some of it off, I just get a hold on my emotions and lie down until the awful feeling eventually vanishes.

Regarding this matter of exercise, General Marshall recently was inspecting a factory in the company of a group of Congressmen—who weren't standing the long, long trail any too well. By the time they'd trudged up and down several miles of concrete lanes, dodging those small power-operated delivery trucks and bumping up against pieces of machinery, they were puffing and blowing and mopping their brows. The General, meanwhile, was striding along at a good fast clip, with nary a sign of wear and tear. "General," said one of the Congressmen, who was puffing along dejectedly behind him, "How do you manage to stand this?—you don't seem tired!" "Ah, that's easy," said General Marshall, vaulting gingerly over a pile of sheet aluminum, "I keep in condition by inspecting airplane factories."

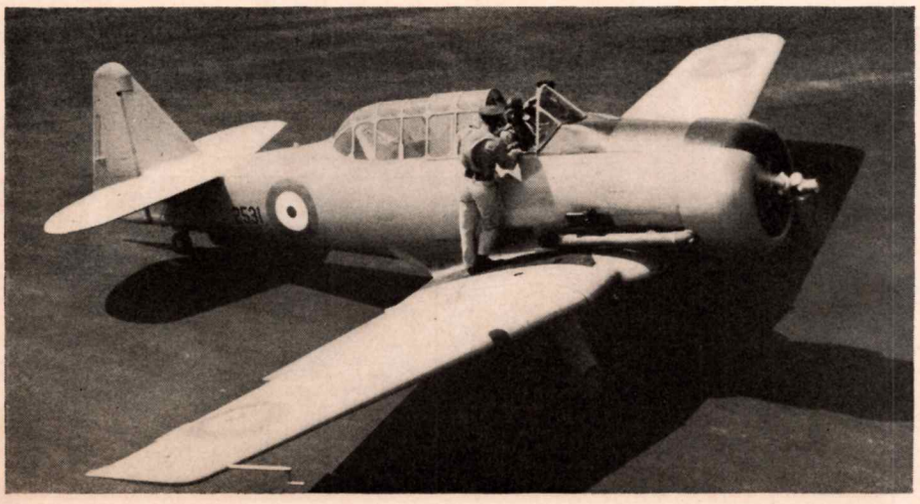
As you probably know, the British Commonwealth Air Training Plan was agreed upon by representatives of the Commonwealth governments gathered at Ottawa in December, 1939—only 15 months ago. The training plan is a vast enterprise undertaken jointly by Canada, the United Kingdom, Australia, and New Zealand to assure a supply of trained airmen to carry on the war against the dictator nations, for years, if need be. Canada is the main theater of training; the Canadian Government is the administrator. The primary aim is to provide the best possible training to the largest possible number of pilots, air observers and wireless operator air gunners. From what I saw, I can assert that the Canadians' aim is perfect. They are hitting the bullseye.

In a recent speech Hitler told the German people, "So we enter the year 1941, cool and determined to end that which started the year before." The Canadians, and the Englishmen, the Australians, the New Zealanders, and the Americans with them, are just as determined, and a lot cooler than Adolf, who always does seem a bit het up. Adolf has promised his Herrenvolk victory this year. The Canadians aren't setting any date. Adolf had some bad luck with his dates for victory last fall, you remember. All of them there in Canada seem to feel that they're just getting down to the business of winning the war, just getting their teeth into the problem. Yet it is whispered—quite unofficially—that they expect to send 30,000 fully trained airmen across to the battle front this year —and by airmen I don't mean ground mechanics. This is "big business."

The plan calls for 83 training schools and auxiliary establishments, such as recruiting centers, command headquarters, repair and equipment depots to a total of 116 units spread all over Canada, with 100 aerodromes and 1860 buildings. The paved runways of these fields are equivalent to 800 miles of highway of the standard 21 ft. width. The staff required for instructors, administration and maintenance of the schools is 40,000 men. A large percentage are Americans.

Cost of the plan, originally estimated at $600,000,000, of which Canada's share was more than half, has been revised to more than a billion dollars, with Canada's share $600,000,000. All costs are shared by the four governments—Canada, United Kingdom, Australia, and New Zealand. It is operated directly by the Royal Canadian Air Force under the direction of the Canadian Government, and a Supervisory Board which includes representatives of the partner governments.

The total of RCAF formations and units in the plan is 116, of which 64



North American "Harvard" Advanced Trainer with retractable landing gear

RCFC instructor and student about to take off on a training flight

were scheduled to be operating Dec. 31, 1940. Actually, 84 were in operation on that date. All not yet completed will be in operation before the scheduled date, September, 1941. The first air crew graduates were sent overseas last October, and the overseas contingents have since mounted steadily in numbers. Adolf demanded total war; the Canadians and the others from the British Empire—together with several thousand Americans now enlisted as instructors and administrative officials and some training to be air crews—are willing to give it to him.

The 17 Recruiting Centers in all parts of Canada have been kept busy. Enlistment is voluntary—no conscription for the Air Force. Far more have volunteered than can be accepted. Those from New Zealand and Australia do their elementary training in their homeland, come to Canada for advanced training, as do those from England.

Prospective pilots must have passed their 18th but not their 31st birthday. Air observers and wireless operator air gunners must have passed their 18th but not their 32nd birthday. Future pilots and observers must have university entrance qualifications; air gunners need two years in high school.

Pilots go to one of three Initial Training Schools for five weeks of military fundamentals, then 7 weeks in one of the 26 Elementary Flying Schools, after which they take a 10-weeks' course at one of the 10 Service Flying Training Schools for advanced instruction. They complete their training overseas.

Air observers take the initial 5-week training course, then go for 12 weeks to one of the 10 Air Observers Schools for training in aerial photography, reconnaissance duties and air navigation. Then follows a 6-weeks' course at one of the Bombing and Gunnery Schools in the science of bombing—they still insist it's a science, but I still have my doubts, considering the factual evidence of the bombing in this war, both German and British. However, as the percentage of actual hits in the Naval battle of Jutland, with guns, was only 2%, the aerial bombardier needn't feel bad.

At the Bombing and Gunnery School at Jarvis I saw a remarkable machine called the Bombing Teacher, a complicated mechanism which simulates actual bombing. It is said that its complexities drove its inventor nuts.

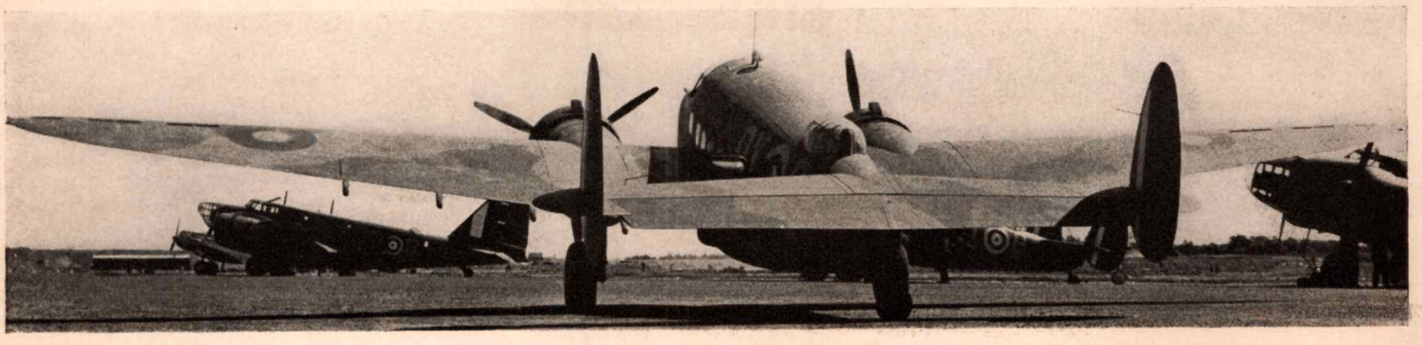
This Bombing Teacher, like the Link Trainer, simulates actual conditions in the air, and therefore saves invaluable instruction time and expense. It is a moving, electrically-operated turntable projecting downwards a moving picture which uses as a screen the ground floor of the building. The machine is on the third floor of the building, which is open through its center. The projected picture of a countryside is on the ground floor, and midway—on the second floor—the bombing student leans out on a platform, and looks through his bombsight at the moving panorama. He is stationary—as he would *feel* that he is stationary in a bombing plane—and the country is unfolding beneath him. As the country moves under him, he moves and adjusts his sight—which is the old-style, hand-operated sight—and when he thinks he is right on the target, he pulls his bomb release. The mechanism stops—and a point of light indicates where the bomb would have landed.

Another interesting device used at the Gunnery School is a power-operated turret—the same kind of turret used in modern warplanes, with an electric-eye gun, with which the pupil fires at an electrically operated drogue, some 6″ long—simulating how the real drogue, or towed target would appear from 200 yds. away. When the gun is right on the target and the triggers are pulled, a little bell rings and there is a flicker of light from the target. The power-operated turret, by the way, is the only practical device for firing one or more machine guns from a movable base on a fast airplane—hand operation of a gun turret is inaccurate, almost impossible on fast planes—and none too good on slow ones. I tried this turret myself—I'd never even sat in one before—and found that with two minutes' practice I could train the gun right on the target and keep it on while the drogue moved up or down. If I can do it, anybody can.

After this ground instruction, the pupils go in the air in Fairey Battles, and do real bombing and shooting at towed targets. At Jarvis, the pilots of these gunnery and bombing planes, and most of the instructors, are nearly all Americans, the majority being from Texas. One asked me, "When is the rest of Texas getting into the war?" And I replied, "It won't be long now"—though in our quaint American way we'll probably disguise it with some flossy phrase like

(Continued on page 96)

Lockheed "Hudson" used for advanced training in bombing



COORDINATING AIRWAYS TRAFFIC ON ELECTRICAL RECORD BOARD

S. P. SAINT

● The mechanics of controlling the steadily rising volume of instrument traffic at La Guardia Field, New York, are becoming increasingly difficult and complicated.

New schedules are constantly being added. And, it is highly probable, that future expansion will necessitate the use of one or more other airports in the metropolitan area, thus further complicating the work that must be handled by Airways Traffic Control. Also, the nature of the airways traffic problem is undergoing a change. Flight procedures are being speeded up. Delays are being cut down.

A new instrument procedure originally suggested by Captain Hiram Little of United Air Lines and now in experimental operation at New York is expected to materially cut the time interval between landings under minimum weather conditions.

With the number of schedules and extra sections at La Guardia almost touching the 300-mark on average days, and airways clearances being issued by the New York ATC office at the rate of 600 or more a day, it is not difficult to foresee the development in the near future of further complications for Airways Traffic Control.

Nerve center of the Airways Traffic Control is the traffic board on which all flights are posted and their separation recorded. While the present type of board is doing a good job of providing positive control records, its capacity must be reaching the saturation point. There appears to be a fundamental quality of this type of board working against expansion, due, perhaps, to the fact that an increase in the number of operator positions at the board makes the proper coordination of all flights more difficult.

As a possible aid in dealing with this particular phase of the problem, this article suggests a design of a new type, electrically controlled traffic record board which it is believed would prove simple, fool-proof, and easy to put into operation.

It offers two theoretical advantages. Most important is the virtual elimination of the human equation, providing a substantial increase in the safety factor. Equally essential is the fact that the capacity of the board may be increased indefinitely.

Any number of duplicate boards may be wired together in parallel, additional operator positions being added at will without sacrificing speed or accuracy to the smooth coordination of the whole. Clearances to flights from all points, electrically checked, may be issued simultaneously by any number of operators with no possibility of confliction.

This electric traffic board would be laid out in plan like an enlarged section of a radio range chart, with the airways in the area divided in blocks by the usual radio fixes, range stations, markers, and range intersections.

Each block would have a set of switches, one for each altitude to be used. Opposite each switch would be a pair of lights—one white, clearly painted with the altitude represented, the other a red warning light. In addition, at each intersection there would be a separate group of red lights, one for each crossing altitude, designated as intersection warning lights.

S. P. SAINT:—Learned to fly in 1929 when he was 17, taking his primary instruction with Universal Flying School, Lambert Field, St. Louis, and his advanced instruction at Cleveland. Returning to Philadelphia, his home town, he completed High School and two years of Mechanical Engineering after which he embarked on an aviation career which culminated in his appointment as Chief Instructor at Somerton Airport, Philadelphia. He remained in Philadelphia until March, 1939, when he joined American Airlines as First Officer

Each set of switches would be mounted in the board so that the plane of action is parallel to the line of flight. Thus an ATC controller desiring to clear a flight southeastward from the Newark range station to the Coney Island intersection at 3500 ft. would depress the proper switch in a southeastward direction.

An arrow on each side of the switch arm would serve to show clearly the direction in which the flight is moving, or would point to the intersection or check point against which the flight is holding.

The switches could be of the multiple position anti-capacity type used in telephone switchboards, each switch having two positions on either side of the center or neutral position. The number one position on either side would simply hold the designated altitude within the block without protecting the intersection at either end of the block. The number two position in either direction would, in addition to holding the block, protect the intersection toward which the arrow is pointing against traffic from any other direction at the crossing altitude.

In order to accomplish this dual purpose, the number one position must supply current to the corresponding white altitude light in that block on each of the boards wired in parallel, and at the same time must supply, through a resistance, a half voltage, or a dim red light to the adjacent warning light on each board. The number two position in either direction, in addition to maintaining the action of the number one position, should also send a half voltage current to the intersection warning light at the crossing altitude. Every action of the lights must be duplicated on all the boards in the series.

Such a board provides mechanical warning so that any confliction in contemplated clearances, either within a block or at an intersection, would instantly and automatically be brought to the attention of all concerned. An operator at another board attempting to clear a flight into a block and altitude already held would supply the additional volt-

age to show on all boards a bright red light at the point of confliction. Similarly, any arrow on a switch directed at an intersection through which a crossing flight has been cleared at the same altitude would supply the additional current to show a bright red light in the proper intersection warning light on each board.

Thus a flight could be cleared through any number of blocks and altitudes by operation of a corresponding number of switches. The switches need only be turned down in the direction of flight in order to prove that the path is clear *before* the clearance is issued. The white altitude lights together with the dim red warning lights would allow the operator to determine by visual inspection which altitudes and intersections are open before operating the switches to initiate a clearance. The switches would not be released until the flight had acknowledged a change of instructions, or the flight had reported vacating a block or altitude held.

Under this plan no blanket clearances could be issued, and no clearance would be issued except to a holding point where flight can hold without confliction in case of unexpected delay. A single switch in the holding leg with its arrow pointing toward and protecting the intersection or check point against which the flight is holding is all that would be necessary to protect the flight after its arrival at this point.

Beside each set of switches there could be fastened a small strip of blackboard, its face painted in squares, one opposite each switch. This would provide space for notation of airline and flight number, and estimate at next check point of the flight holding the altitude represented.

A Typical Clearance

A typical clearance is held on the section of the board shown in the illustration. As standard procedure, the initial airways clearance to American AM-7 Flight 62 was to the outer edge of the traffic board, shown as Newton Intersection (about 45 miles northwest of Newark) where the northwest leg of the Newark range intersects the northeast leg of the Allentown range.

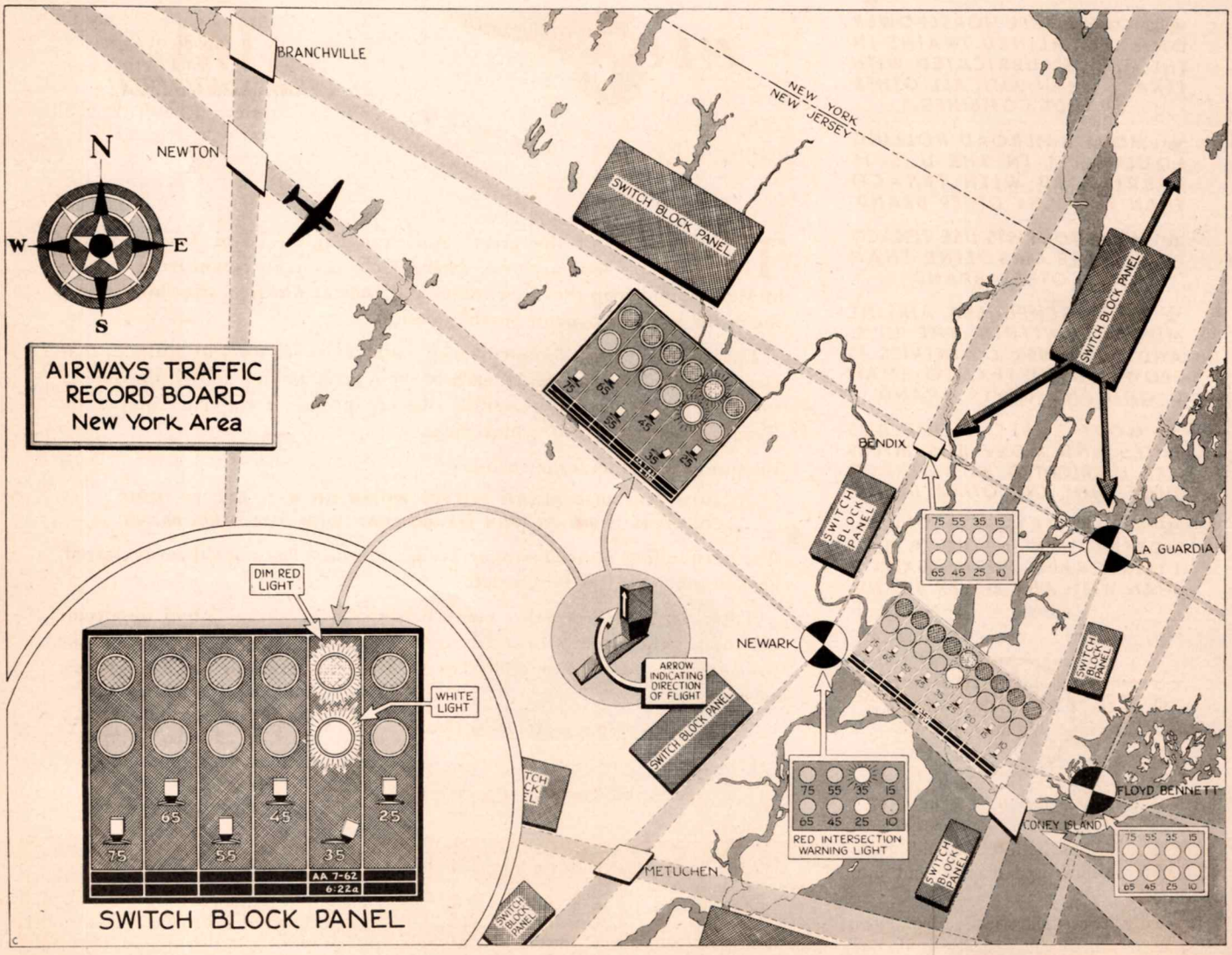
On receiving Flight 62's report over Newton, the controller who is to handle the flight on the traffic board, deciding that Flight 62 can be cleared to Coney Island at 3500 ft. without tying up other traffic, merely operates the switches as shown in the illustration, and then issues the clearance as follows:

"American 7-Flight 62 is cleared from Newton to Coney Island intersection, to cross Newark at 3500, Coney Island at 3500, hold 3500 at Coney Island on the southwest leg until further advised. No delay expected."

When a flight is cleared, as it is in this case, to hold on some other leg than the one on which the flight is approaching the intersection, the switch in the holding position southwest of Coney Island would be left in the number one position until the flight actually reaches Coney Island. Before the flight reports Coney Island the holding area is adequately protected by the combination of the arrow directed at Coney Island from the northwest and the switch on the southwest leg which so far is merely holding the block open.

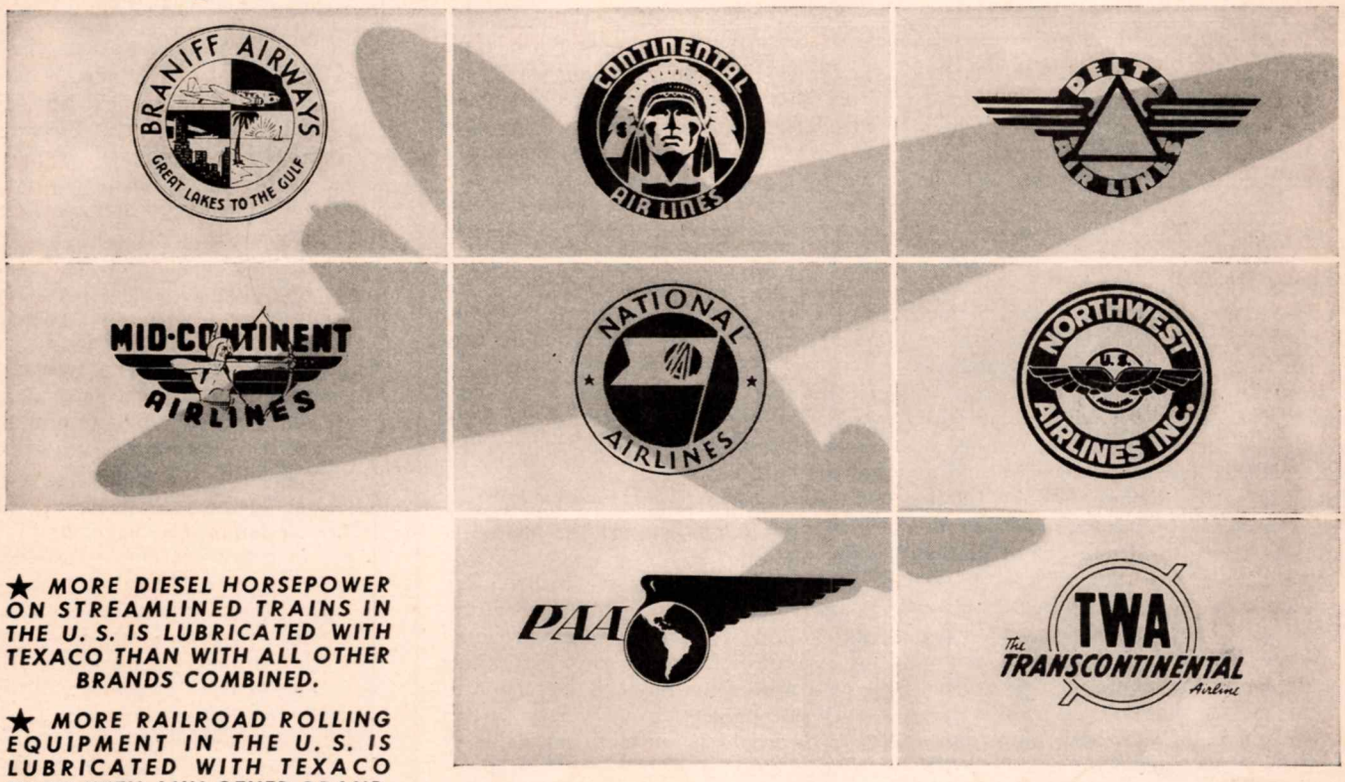
As Flight 62 reports crossing Newark, the switch in the Newton-Newark block

(Continued on page 50)



Composite drawing showing relationship between suggested traffic record board and radio range map of New York area. In actual construction, the range pattern would be somewhat distorted to provide adequate space for each switch block panel used

Eagles that keep Cost Records



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(Continued from page 48)

is released. When he reports over Coney Island, holding at Coney Island southwest, the switch in the Newark-Coney Island leg is released and the switch in the block southwest of Coney Island is put in the number two position with its arrow against the intersection to continue protection of the holding area.

Entirely separate from the boards in Airways, and yet functioning in exactly the same manner, could be a set of boards, one in each airline office, wired together on a trunk circuit, operated by the airline dispatchers according to their understanding of clearances received from Airways. These boards would not only provide a check of the proper mechanical functioning of the Airways boards, but, more important, they would check the interpretation of the clearance as received by the airline dispatchers against the original clearances.

If it were thought advisable for purposes of instant record comparison, a Master Board having no switches and a duplicate set of lights could be established in Airways, to have one set of lights tied into the trunk circuit of the airline boards and the other wired in parallel with the Airways boards. Any discrepancy between Airways and flight dispatchers, whether it caused actual confliction or not, would then be evident on this master board.

It would be of vital importance, however, that any confliction caused by a misunderstood or misinterpreted clearance, or a clearance improperly switched in Airways, would light the proper warning light on all the airline boards. Naturally the dispatcher involved would not turn the clearance over to radio for transmission to the airplane until the board had been cleared.

At the same time, it should be of almost parallel importance that the time involved in this check and double check would be a matter of seconds only.

In order to complete the picture, some revision of communications procedure might be advantageous.

Each airline could be provided with its own interphone having direct contact with all of the operator positions on the ATC boards. Any ATC controller could then issue a clearance to any company flight dispatcher by picking up that company's interphone.

For the purpose of providing a positive written record, a teletype operator might be tied into each interphone circuit. This operator could type clearances and instructions as issued, to appear on a printer beside the company dispatcher as well as on the teletypewriter in Airways. Incoming reports and requests from ship to ground could, according to present procedure at New York, be put directly on teletype to Airways by the radio operator. The Airways copy of clearances together with incoming teletype reports from the flight could be posted in a rack convenient to the controller handling the flight until the flight is on the ground or outside the boundary of the board.

Handling Reports and Requests

In addition, a series of small moving belts could be set up, one to each operator position, to carry reports and copies of clearances from the bank of printers to the proper controller.

Thus complete two-way typewritten records would be instantly available at all times to the ATC controller on one end and the flight dispatcher on the other. The advantages of the interphone would be retained; its weakness eliminated. Handwritten clearances and notations, with the exception of flight number and estimates beside the switches on the traffic boards, will be eliminated in both offices.

It is estimated that the average time necessasry for a clearance to be issued by Airways, double checked by company dispatcher and put in the hands of radio for transmission to the airplane would be less than 30 secs. using the suggested design of traffic record board.

The switches with their accompanying notations in the airline operations office would provide a constant visual record of the position and estimate of each of that company's flights in the area. Also, being wired in parallel with the other airline boards, the remaining lights on the board would give the dispatcher a picture of the blocks and altitudes held by all other traffic.

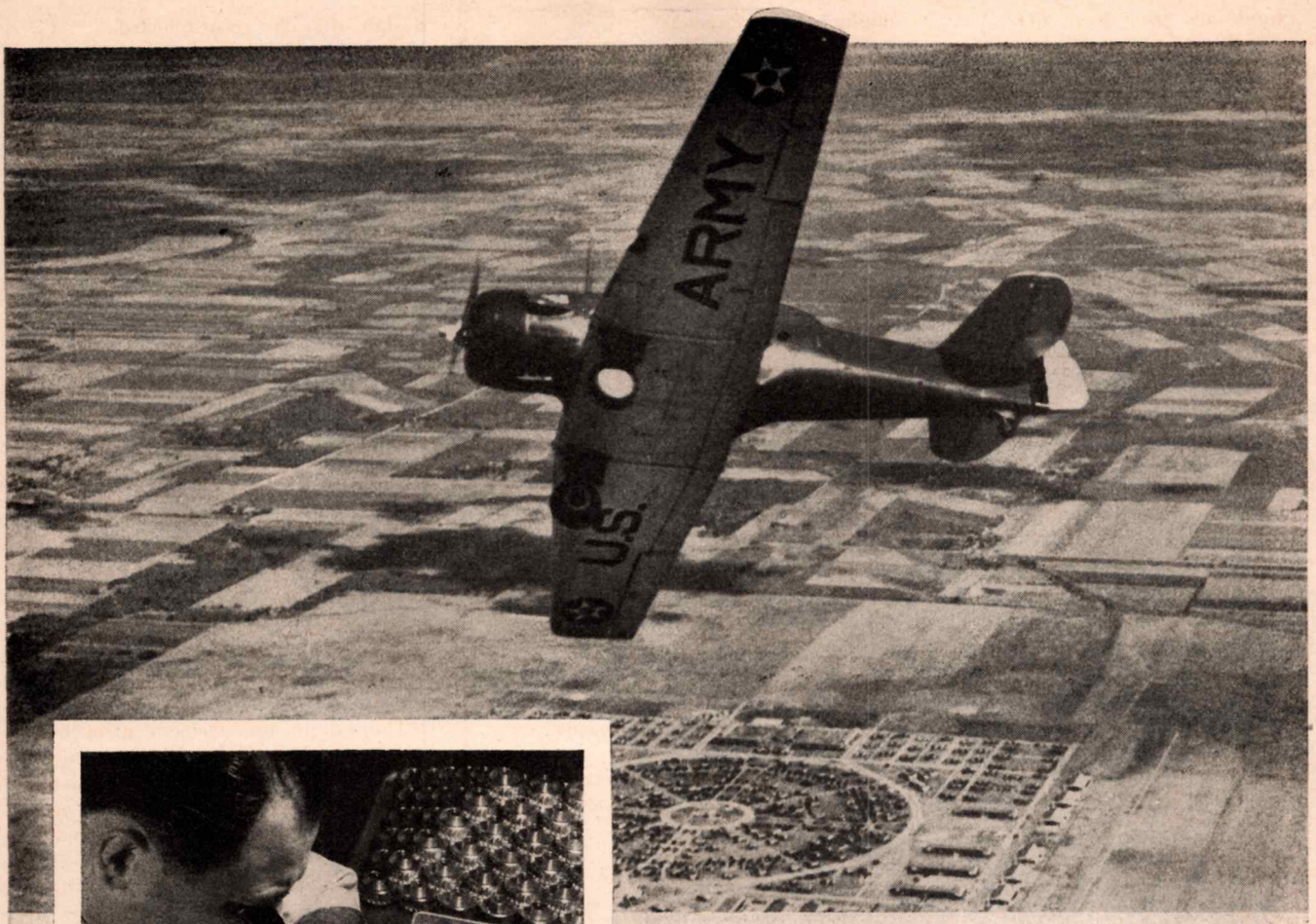
It is essential to the efficient operation of the ATC office that the number of controllers necessary to operate the traffic boards be flexible, thus making allowance for changing traffic conditions and peak periods. During the early morning hours when there are few trips in the area, the traffic could be consolidated on one or two of the boards.

Of particular consequence at New York, is that the use of this type of traffic board should facilitate and simplify future changes in routing and procedures made necessary by possible use of Floyd Bennett Field or the reopening of Newark Airport.

The use of this traffic control board should provide an invaluable supplement to the new "Range Control" procedure for speeding up approaches, now in experimental operation at La Guardia Field. This traffic board could be set up to include those blocks and altitudes handled by Range Control. The approach controller could be provided with a traffic board wired in parallel with the ATC boards, thus allowing flights to be changed at will from one authority to the other in any position without danger of confusion.

Two final advantages would insure safe transition from the existing methods of traffic control to the one suggested here. The system could be set up and operated experimentally parallel to and without change to the present system until it was deemed safe to throw the weight of direct authority on the traffic boards. No change in pilot procedure would be involved.

Range control procedure is speeding-up arrivals at La Guardia Field—requiring emphasis on flight control



Working under controlled atmospheric conditions, in a thoroughly modern plant, Pioneer Craftsmen, build what we believe to be the finest aircraft instruments obtainable. Above is shown one step in the assembly of Pioneer Turn and Bank Indicators, one typical and familiar instrument of the many built by Pioneer.

. . . because

they're "banking" on *Pioneer Precision*

If every young student pilot, learning air confidence through hours of flight training could look, with full understanding, into the Pioneer plant, his faith in his flying equipment would be inspired enormously. He would see there some of the protective carefulness that safeguards his air adventuring. He would watch the work of fingers and eyes trained by years of practice, to perceptions so keen that a thousandth of an inch has become, for them, a coarse measure indeed! He would know then, and would never forget, that consummate skill and conscientious craftsmanship are among America's surest and most priceless assets.

PIONEER INSTRUMENT

DIVISION OF BENDIX AVIATION CORPORATION

BENDIX, NEW JERSEY, U. S. A.

WESTERN AIR LINES CELEBRATES FIFTEEN YEARS OF SERVICE

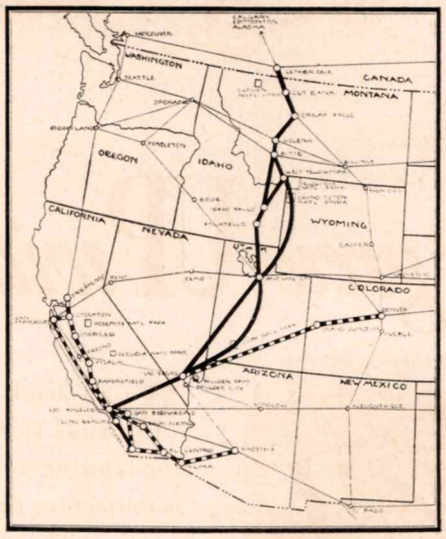
● When Western Air Express celebrates its fifteenth birthday on the 17th of this month, it will look back on an enviable record of achievement, attained despite the trials and tribulations generally associated with any pioneering venture.

One of the first of the independent operators to petition for a route following the Post Office Department's decision to turn over the air mail system to private enterprise, Western Air becomes the first American airline to complete a decade and a half of continuous service. Yet, the heritage which has seen the enterprise pioneer the first scheduled passenger service, the first use of deluxe multi-engined equipment, and the first complete weather reporting service, is somewhat overshadowed by the fact that the name so long associated with air transportation in the west, has been partially lost to progress. For on March 11, the company's stockholders voted to call their company Western Air Lines, Inc., to more adequately describe its multifold functions of carrying passengers, mail and express.

Fifteen years ago on April 17, 1926, a Douglas M-2 biplane took off from Los Angeles for Salt Lake City on a memorable flight. It was the first scheduled run of Western Air Express under AM-4.

Powell Press Service

"Pop" Hanshue and C. C. Moseley



And on this April 17, when Western Air celebrates its anniversary as the first domestic airline to achieve such a record without change of identity, the same M-2 will take to the air once again. Civic celebrations will be held in principal western cities during the week preceding the history-making flight and the anniversary event. At the controls on the celebration flight from Los Angeles to Salt Lake will be Jimmie James and Fred Kelly, the ship's first pilots in 1926, but now Western Air's vice-president in charge of operations, and superintendent of flying, respectively.

To interested by-standers, the M-2 is a sentimental symbol, a standard by which to measure aviation's progress. They know that the little plane will be passed in its ceremonial flight to Salt Lake by Western Air's Douglas DC-3 Mainliners on their scheduled runs, and they know that the modern plane will wear the same traditional Indian-head insignia that the M-2 instigated on its first run in 1926.

There is a deeper significance, however, to the anniversary of Western Air. In the chronicling of airline history, there is no more dramatic story than that of the company's early pioneering, its growth during which there was established wide-spread new routes that today are integral links in the systems of other transcontinental airlines; of Western Air's predicament at the time of the air mail contract cancellations in 1934; of the threat of the company's loss of identity under a proposed merger, successfully defeated; of the slow, often discouraging attempts of the company to re-establish itself as an airline of far-flung importance.

And now, at its fifteenth anniversary, a great measure of success for these latter endeavors at last becomes evident, with promise of even greater future to unfold.

Even as it achieved success in its early days through the pioneering of new routes, so has it done today in winning part of its recent success. After a long campaign, Western Air has won an extension from Great Falls, Montana, to Lethbridge, Alberta, Canada. This gives the company a north-south border-to-border service, extending from San Diego to Lethbridge, where it connects with airlines serving Canada and Alaska.

Last year also saw Western Air score vigorously in another way. When the government denied the Western-United Air Lines merger, it nevertheless granted the first approval in history for the interchange-of-equipment program for two airlines, under which Western Air Mainliners now fly transcontinentally east and west from San Diego and Los Angeles to LaGuardia Field, New York.

To augment these achievements, Western Air is staging a drive to expand its services with additional routes that would once again dispose an impressive network of service throughout the West.

A lusty, pioneering success was achieved by Western Air quickly in its early career. It got pay-dirt out of airline operations, with the new routes it surveyed and started, and which are now important segments in the east-west routes of other transcontinental airlines.

First seeds in the development of Western Air were planted in the summer of 1925, when Harris M. (Pop) Hanshue and a group of some 50 California and Utah business men got together to foster commercial aviation in the West. They incorporated on July 13, 1925, with an authorized 5000 shares of $100 common stock, of which 4283

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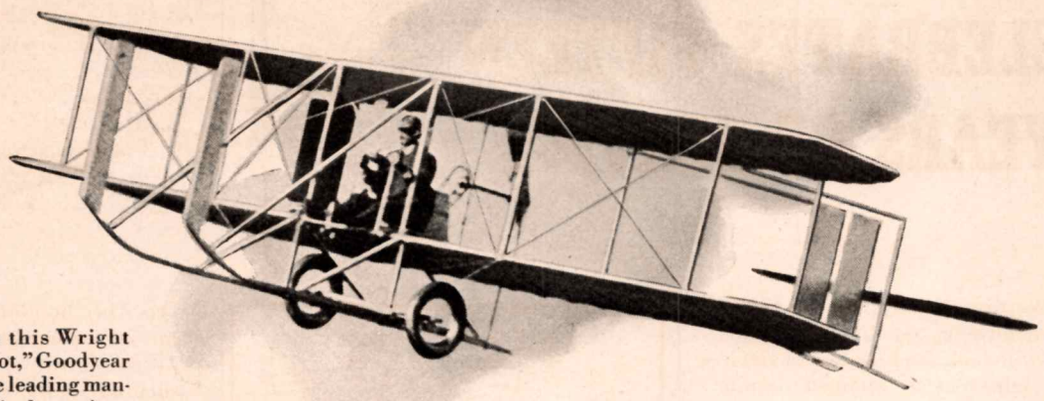
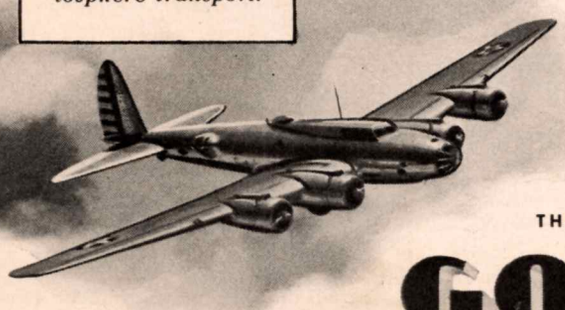


In 1912 when this Wright biplane was "hot," Goodyear was already the leading manufacturer of airplane tires.

These tires grew UP *with aviation*

Man-sized Goodyear Airwheel on substratosphere transport.



WAY back when airplanes were still using sled runners and bicycle wheels for landing gear, Goodyear first began to manufacture tires specially designed for air service. Through close cooperation with pioneer fliers we learned how to build progressively bigger and better tires to meet their needs on bigger and faster ships. And because we have continued to work in close harmony with pilots, aircraft designers and manufacturers, you will find Goodyear tires today on a very great many of the largest transports and fastest fighters. To equip these "hot" new ships Goodyear offers a complete line of tires of time-proved durability and safety—together with the tubes, wheels and brakes necessary to a perfectly balanced wheel assembly. Our long experience is at your service in solving all tire, tube, wheel and brake problems. Just write: Aeronautics Department, Goodyear, Akron, Ohio or Los Angeles, California.

THE GREATEST NAME IN RUBBER

GOODYEAR

ON YOUR NEW SHIP *SPECIFY* GOODYEAR AIRPLANE TIRES, TUBES, WHEELS AND BRAKES

Airwheel—T. M. The Goodyear Tire & Rubber Company

Powell Press Service

Initial fleet of Western Air Express mail planes

(Continued from preceding page)

shares were issued. Pop Hanshue was the first president.

On Sept. 15, 1925, the new company bid for a mail contract between Los Angeles and Salt Lake City *via* Las Vegas. Awarded the contract on Nov. 7, it hired Fred Kelly as its first pilot on Dec. 1; he surveyed the route, and operations began on April 17, 1926, with a single daily round-trip in Douglas M-2 biplanes powered with 415 hp Liberty engines. The ships had a speed of 110 mph and range of 600 miles.

Kelly was joined by C. N. "Jimmie" James, Al Garmo and the late Maury Graham. This was the full pilot staff. Major C. C. Moseley, now head of Curtiss-Wright Technical Institute and Cal-Aero Academy, was the first general manager as vice-president in charge of operations.

Hanshue, Moseley, and two clerks made up the office staff; the maintenance crew was composed of five men —three in Los Angeles and two in Salt Lake City. Today, Western Air has 42 pilots, 100 maintenance employees, and 275 other employees.

Only mail was carried during Western Air's first month of operation, but on May 23, 1926, Ben F. Redman paid his fare and flew to Salt Lake with Kelly.

Between the inauguration of its first service and the cancellation of air mail contracts Western Air established services between Cheyenne and Pueblo *via* Denver, with later extensions to Albuquerque, El Paso, and Amarillo; between Los Angeles and San Francisco with the cooperation of the Guggenheim fund, a route which, with personnel and equipment, was later transferred to TWA; an amphibian service from Wilmington to Catalina Island; Los Angeles and Kansas City; and between Los Angeles, El Paso and Dallas.

Technical advance of Western Air in flying, maintenance, and equipment is essentially similar to that of all domestic airlines. The Douglas M-2 gave way to Boeing 95's, Boeing 40B-4's, three- and four-motored Fokkers, the Douglas DC-2's, and finally to the modern Douglas DC-3 and DST Mainliners.

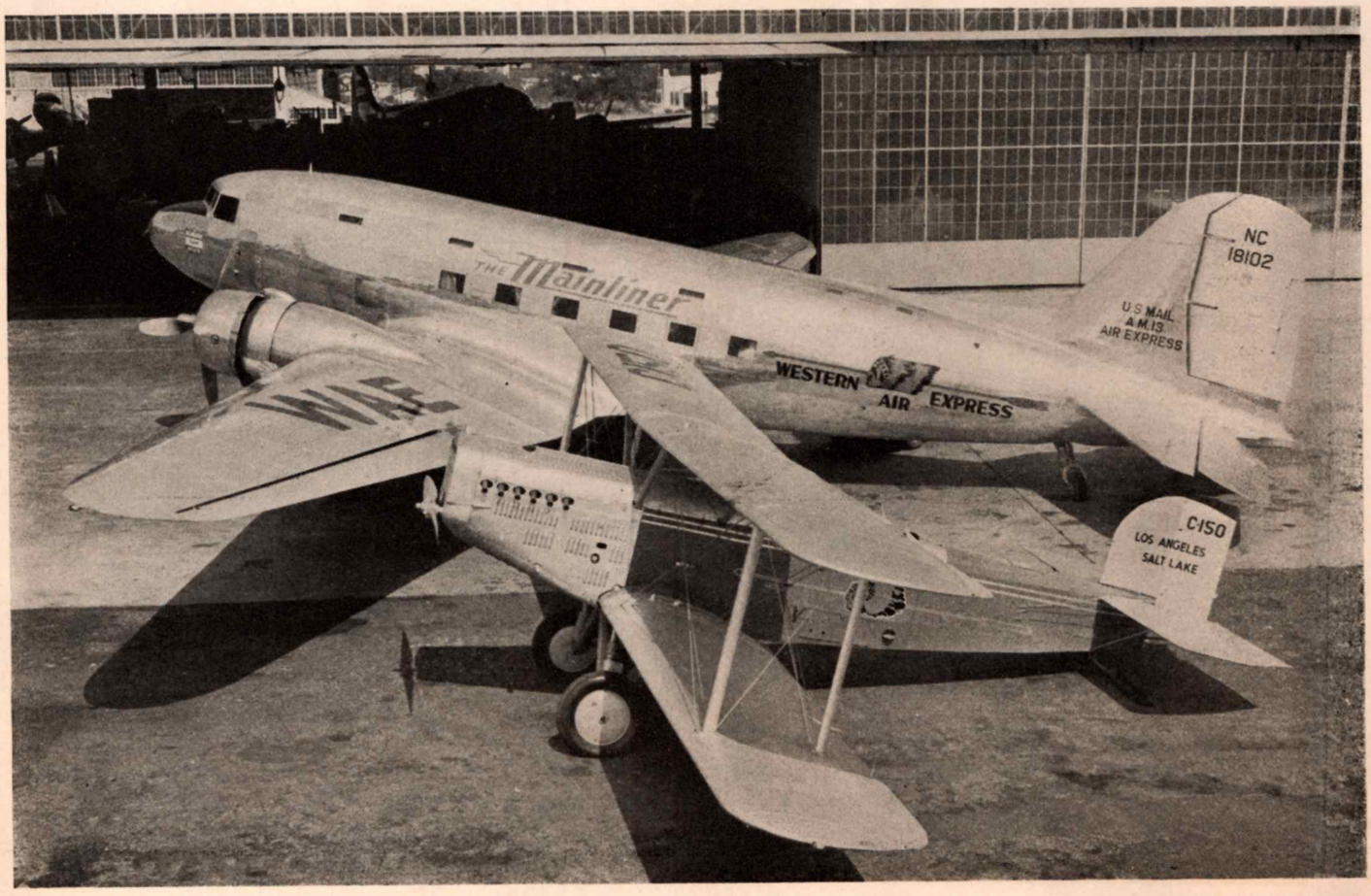
Western Air experimented with two-way radiotelephone between planes and ground stations, and equipped its planes with radio in the summer of 1929 with such success that it became standard on all lines. The company also pioneered the first "air mass analysis" system of forecasting weather for airline dispatching when it hired Dr. Irving Krick of the California Institute of Technology to conduct research and tests. Night flights were started between Los Angeles and Salt Lake in 1928 with the installation of beacon lights between these two points; and airway radio beams were first installed on the route in 1929.

In 1934, with the chaos of the air mail contract cancellations and subsequent legislation, Western Air emerged with only a San Diego-Salt Lake City route operating *via* Los Angeles and Las Vegas.

Then began the long up-hill fight to rebuild. The first step in the company's

(Continued on page 96)

Then and now—a modern Douglas DC-3 and one of the original Douglas biplanes used by W.A.E.



★★★ IN THE FRONT OF OUR AIR DEFENSE ★★★

Pointed for Pursuit!

Here you see two reasons why the Army's Curtiss P-40 is one of our foremost fighting planes—its Allison liquid-cooled engine and the advanced streamlining this engine's in-line design permits.

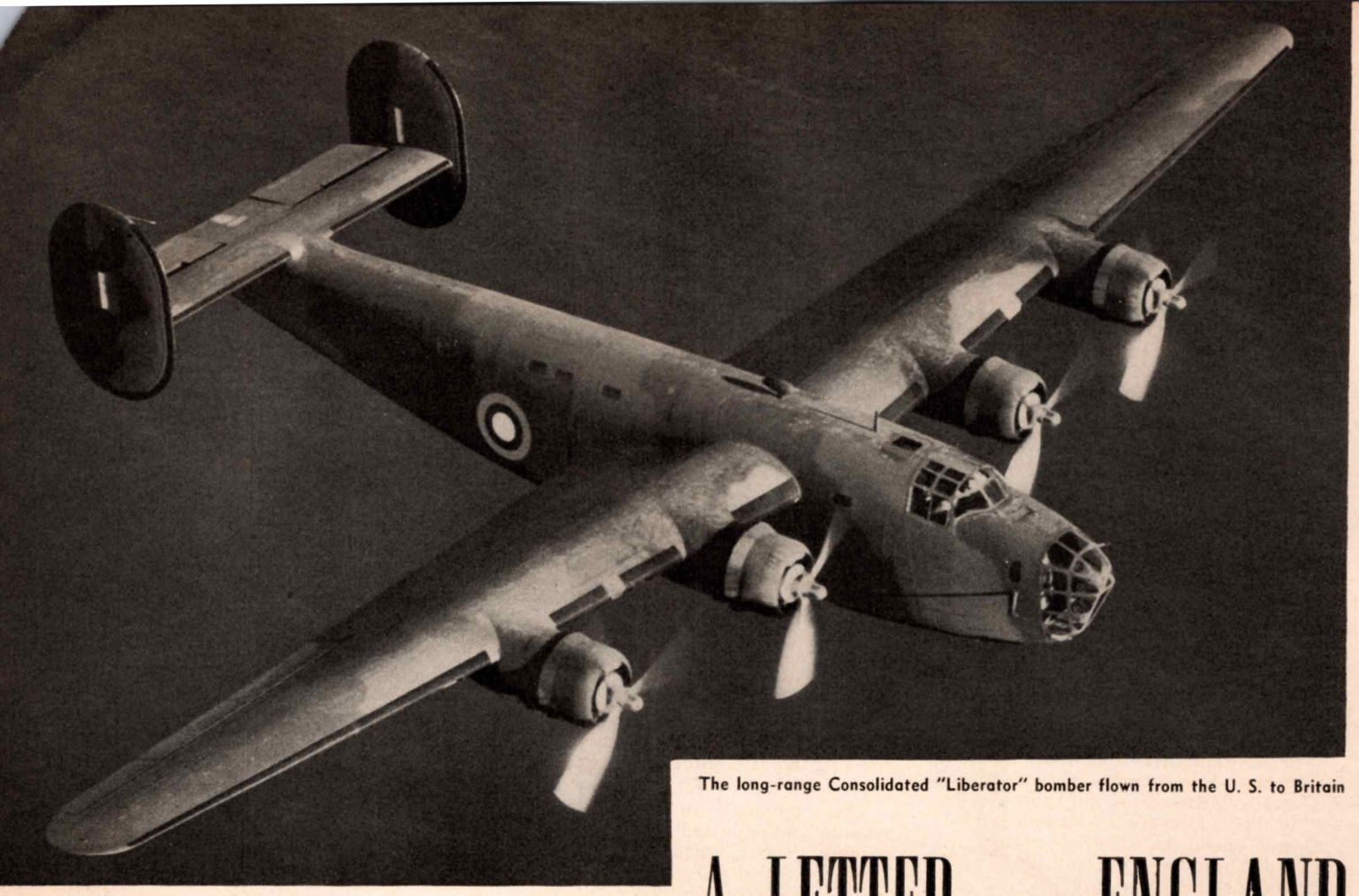
And in this advanced air power, made possible through the collaboration of the American Aircraft Industry with the U. S. Army, you see a conspicuous example of industry and government united in defense of these United States.

Allison

LIQUID-COOLED AIRCRAFT ENGINES

GM GENERAL MOTORS

DIVISION OF GENERAL MOTORS



The long-range Consolidated "Liberator" bomber flown from the U. S. to Britain

A LETTER FROM ENGLAND

The following letter contains interesting personal observations on England's reaction to the war and particularly regarding American aircraft now in the RAF. A cabled request for permission to publish it brought a prompt and laconic "go ahead."

From John W. Morrison to Cy Caldwell

DEAR CY:—

The December number of AERO DIGEST has put in an appearance at last. The man in the Irving St. book stall probably thinks I'm a bit touched; I pestered the fellow for the November number several weeks. Then we learned that Jerry sent it to Davy Jones' Locker, the first time your magazine failed to reach me in England thus far.

War naturally results in the rather complete mutilation of our own periodicals with a resulting lack of fuel for creative thought. Quite apart from this, American journals have always set out to give their readers an impeccable service that, in my humble opinion, is not equaled in any other country. Were I in the Air Ministry I should see to it that such losses as do occur be made good.

Although I have been in London continuously throughout the blitz I feel in no way inclined to get out. One tends to regain a sense of security that may be difficult to understand, but is none-the-less real. London is so big that the effect of concentrated attack is lost—it can only be concentrated on one section at a time.

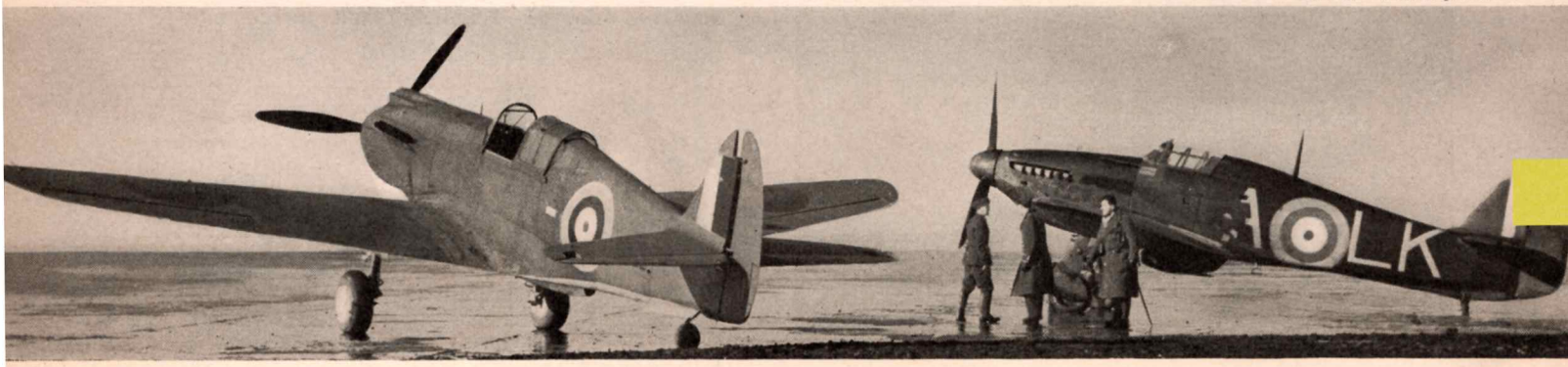
Initial surprise after which failure to follow up quickly with an occupation, results in a steady return of confidence. Even the bombing of Rotterdam, the most murderous attack in history, has hit the Germans on the rebound. When the Nazis ask the Dutch for a little cooperation, the word "Rotterdam" comes to mind.

One thing is certain. Jerry has never been in such a geographically favorable position as he is today with jumping-off places from the Arctic to the Pyrenees. One Heinkel 111 alone is easily capable of shuttling more than 8 tons of high explosives across the Channel in a night and yet, I don't think that we have ever had more than 1000 tons in a night. Theoretically, they could drop 10,000

(Continued on page 58)

Curtiss "Tomahawk 1" fighter (left) and a British "Hurricane"

British Combine photo



The Birdmen's Perch

Editing this page, is one series of surprises after another. I'd just about given up on getting any more stories about boners while flying. And then all of a sudden the customers seem to lose their bashfulness and I get dozens of 'em! You'll find this month's choice printed below.

Major Al Williams, alias "Tattered Wing-Tips,"
Gulf Aviation Products, Gulf Building, Pittsburgh, Pa.

FUNNYBONER DEPT.

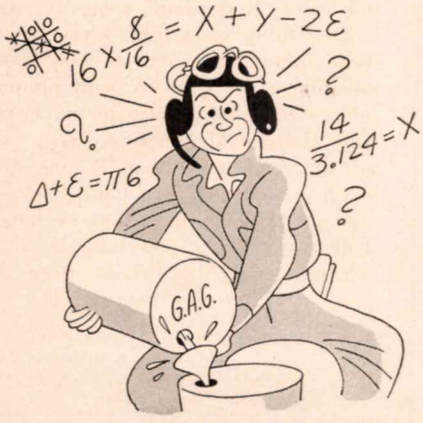
Last summer I had to make a rush trip to Salt Lake City. Upon approaching the field, the red light in the tower showed closed so I circled until the approaching air liner came in. By this time I was well away from the field and anxious to get down, so I peeked back over my shoulder to see if the clear lights would flash. But because of the position of the ship it was impossible to see, so did I turn the ship or slip it? I did not. I poked my old bald head out of the window and Zing! went a $22.00 pair of glasses. Why can't a person learn things more easily?

J. P. INNES,
Ogden, Utah.

Mr. Innes, you have our sympathies. We've yet to meet an airman who got his experience free of charge.

HOW TO GO WACKY DEPT.

The juggling act printed below is from Mr. Carol Henry of Rapid City, S.D. Do your worst, fellows. *We* know the answer.



A pilot made a forced landing on the South Dakota plains. He had in the baggage compartment two drums of Gulf Aviation Gasoline. The first drum was too heavy so he poured 12 gallons into the second drum. The first drum then contained 6/11 of the amount in the second drum. If he had poured 16 gallons back into the first drum, the second would have contained 7/10 of the amount in the first. How many gallons of G.A.G. did each drum contain?

IT DOESN'T LOOK UNUSUAL . . . BUT IT IS!

We received a mighty nice letter from one of our readers the other day, expressing his appreciation of the many things Gulf goes out of its way to do for airmen. We really appreciated his sentiments, but we'd like to remind you, and him, that one of the *finest* things Gulf does isn't quite so apparent.

That's the extra trouble we go to in refining Gulfpride Oil. Besides regular refining processes, we put it through an extra process that removes up to 20% more of the carbon-and-sludge formers. This doesn't show up in the *looks* of the oil, but it does show up in the way it stays "up" in your motor and pares engine wear and repair bills.

THIS MONTH'S WHOPPER

Dear Major:

I am, along with 6,340 more boys, very grateful to the makers of that good old Gulf Aviation gas, for the splendid way in which they have pushed education ahead here at Texas A & M. Yes, it has really rushed things up for us, or at least it did for a couple of days. It isn't too long a story so here goes:

About the 20th of December, last year, the college airport manager had his underground tanks filled with G.A.G. By the 3rd of January, the tanks were empty and the dealer was called out to refill them. Unfortunately (or should I say "fortunately") the dealer was out of town and sent his helper. The boy had put in only three gallons when he decided he wanted to light his pipe, which he promptly did. Well, it's the same old story of the lighted match. It landed right in the middle of the gasoline! The tank, boy, and three gallons went sky high!

The surprised but unhurt lad landed close to Dallas in some farmer's silo; the tank was found near San Antonio; but the G.A.G. formed a cloud above the campus!

The next day the weather turned off bad and the ceiling became absolute zero. The cloud of G.A.G. settled upon the campus

like bees upon the comb. Night came. Everyone opened their windows to let in the wonderful fresh night air. By the next morning, everything and everyone was thoroughly saturated with a dilute solution of that powerful G.A.G.! BELIEVE IT OR NOT! WHAT LITTLE G.A.G. WE HAD BREATHED WAS POWERFUL ENOUGH TO GIVE US THE ENERGY AND SPEED TO FINISH A WHOLE MONTH'S SCHOOL WORK, TAKE THE FINAL EXAMS, AND REGISTER FOR THE NEXT SEMESTER, *ALL IN THE SPACE OF 48 HOURS!*

Thank goodness, you didn't make it a mite more powerful because an hour later the effect had worn off! Naturally, we had the rest of the semester off, thanks to Gulf's great contribution to the aviation world! This is why 6,340 Texas Aggies appreciate your famous product now, if they didn't before!

By the way, the boy is now SHINING SHOES FOR A LIVING!!

Sincerely yours,
JOHN M. HOLMAN
alias "Shattered Rudderbar"

Gulf Oil Corporation and Gulf Refining Company . . . makers of

GULF **GULF AVIATION PRODUCTS**

British Combine photo

Grumman "Martlet" fighter in the service of the RAF

(Continued from page 56)

tons, production being the limiting factor. In the same way, we could shuttle an unlimited weight of h.e. to the Channel ports.

Your exposition of the Italian position was interesting reading. A few months ago, Musso seemed to be holding all the aces, but now you can hardly see the Italians for dust. According to them, we had 500 aeroplanes in Egypt a few month ago, and I estimated that they outnumbered us at least 3 to 1. We never pretended that the aircraft we used against the Italians were modern types. The *Gladiators* in service in Libya must be among the oldest planes still on active service; the Bristol *Bombay* is no chicken, a 7-year-old design with a top speed under 200 mph. The most modern aircraft we are pitting against Musso are 6-year-old designs, the *Hurricane* and the short-nose *Blenheim*.

As for Musso's Navy . . . the torpedoing was done with Fairey *Swordfish* aircraft, and if ever there was a genuine antique—well, you have only to look at a photograph. These aircraft with their top speed of 154 mph practically wrote off Mussolini's Capital ships. I have maintained that the aerial torpedo attack would be the greatest menace to any Navy. The way I see it, a pilot with guts in a torpedo-dropper is worth 100 *Stuka* dive-bombers.

So far we have torpedoed Capital ships of 3 nations—German, French, and Italian. Our heaviest losses against enemy naval forces with aircraft have taken place in the North Sea. When an attack is pressed home against a Capital ship with an escort of 50 Messerschmitt 110s and a dozen Destroyers, heavy losses can be expected.

Recently I have been reading articles by the late General Billy Mitchell. He didn't go much on aircraft-carriers operating against land-based aircraft. If he were alive today he would have been dumb-founded at the recent audacity of the Royal Navy in getting a convoy through the Narrows between Catania and the African coast with masses of *Stukas* only a few miles away and only one Carrier to take on the whole outfit, to say nothing of a number of torpedo-droppers and the possibility of attack from bases in or near Tripoli, Bizerta, *etc.* Add to this the possibility of lurking subs, mines, *etc.*, and you will realize that it was no picnic.

The amazing Greeks have achieved the seemingly impossible. I didn't know they had an Air Force. Your figures of 150 to 200 machines would mean a first-line strength of not more than 50 planes, say 2 bomber and 3 fighter squadrons. It has now been revealed that the Greeks dispersed their tiny force almost down to an individual machine well away from its neighbor so that the destruction of even such a small force was rendered difficult for the Italians. I doubt whether the latter ever found the Greek Air Force.

General Papagos has given us an opportunity to get an unexpected foot-hold on the Continent again, although it does appear useful only against Italy. On the other hand, the Luftwaffe is getting a

(Continued on page 61)

British Combine photo

Douglas "Boston II" DB-7 medium bomber flown to England

Curtiss SNC-1 Trainers for the U.S. NAVY

Designed for the final step of training before combat pilots transfer to fighting aircraft, a new advanced Navy trainer, the Curtiss SNC-1, takes its place with the growing list of Curtiss airplanes serving with our defense forces of sea and land.

This all metal, full cantilever, low wing monoplane is a development of the CW-22 type produced in the Curtiss-Wright St. Louis plant for the past two years. Powered with a Wright Whirlwind, it is equipped with a retractable landing gear for increased speed and maneuverability, and incorporates a tandem cockpit arrangement for instruction purposes.

HUNTER WOOD

CURTISS-WRIGHT

CURTISS-WRIGHT CORPORATION
AIRPLANE DIVISION
BUFFALO PLANTS

CURTISS-WRIGHT CORPORATION
AIRPLANE DIVISION
COLUMBUS PLANT

CURTISS-WRIGHT CORPORATION
AIRPLANE DIVISION
ST. LOUIS PLANT

180 Stearman Trainers ★ IN 16 DAYS

WHEN the U. S. Army and Navy issued an emergency call recently for additional primary trainers, Stearman met this call by completing 180 planes in 16 days, working three shifts a day and seven days a week in an accelerated national defense effort. This production record was made in the midst of factory expansion, which has tripled the floor space of the main Stearman plant. Meanwhile, Stearman is steadily continuing to fill contracts for the largest number of primary trainers ever ordered in peace-time by the United States from one manufacturer.

STEARMAN AIRCRAFT DIVISION
Wichita, Kansas

Boeing

BOEING AIRCRAFT COMPANY
Seattle, Washington

STEARMAN TRAINERS

British Press Service

Wright Cyclone-powered Brewster "Buffalo" fighter

(Continued from page 58)

hold in west Libya on Derna, and we may soon be scrapping with the Nazis in Africa. That won't worry the Aussies. (It is 11 pm; Jerry has turned up so I think I shall have a bath).

To my mind, the equipment of the Fleet Air Arm is below par. Admiral Sir Roger Keyes' criticisms in this direction have never been convincingly answered. Our fastest British Naval fighter, the *Fulmar*, is not capable of even 300 mph. It was never intended as a Naval aircraft, and is 30 mph slower than the Grumman F4F-3 with a Wright G-200 9-cylinder radial engine. This American fighter is probably the best in service anywhere in the world, and its 1200-mile range is something like a ship-borne fighter range.

The importance of long range for ship-borne aircraft cannot be over-estimated. You can never be certain that the deck of the Carrier will not be bombed while its fighters are engaging enemy aircraft. With the deck out of commission there must be sufficient range in hand to reach land aerodromes many hundreds of miles away, otherwise, the only alternative is to put down on the water and hope for the best.

As Mitchell so often pointed out, it is theoretically impossible to carry out an offensive action with ship-borne aircraft against land-based forces of the enemy because of the superior numbers of higher performance machines that the enemy can bring into action. If we had a few thousand Grumman *Skyrockets* and Vought-Sikorskys (said to be about 130 mph faster than our fastest Naval fighter) the chances are that powerful land-based forces could be engaged and destroyed. To do this we would need about 40 aircraft carriers of the largest type.

As a weapon for attacking Capital ships, the *Stuka* proved to be too light, the 500 kilo bomb being not much better than a pellet when it hits the deck armor of a ship like the H.M.S. *Rodney*—it simply bounces off. I understand that the newest German dive-bombers carry a 1000 kilo bomb.

You ought to have been here last summer when the heaviest attacks were on. The roar of hundreds of bombers and fighters in action at once fairly filled the air, and sound seemed to come from everywhere at once. Then, out of this background of noise, was the most thrilling sound I ever heard rising above the general din, the screeching of maddened *Hurricanes* and *Spitfires* diving at 3600 rpm.

Jerry has always put a high value on noise and my own introduction to screaming bombs convinced me that noise is of the utmost importance. Although the bombs landed nearly a mile away they might well have been personal callers judged solely on the score of noise. Not content with this, Jerry attached a noise-producing device to his engines to give the impression that the plane was only a few hundred feet above, when in reality, it may have well been at 20,000 ft.

Be that as it may, in an aerial battle Jerry doesn't get a look in. The slow pop-pop of his cannons gives a less impressive sound than the shattering roar of 8 rifle-caliber machine guns. On a number of occasions our pilots have succeeded in sawing an enemy machine in two. However, the cannon is now being universally adopted as I have always maintained it would be.

Even on the clearest day, it is difficult to see what is going on. The frontal attack from slightly above and to the side surprised me most, the firing lasting about 2 seconds or less before the opposing machines had passed one another at a combined velocity of some 600 mph.

Our great difficulty in meeting the German attacks with tiers of escort fighters was that of concentrating enough defending fighters in one spot; the defending force must be ready to meet attacks from a hundred different quarters, hundreds of miles apart. Another problem was the Me 110. We were in effect pitting bantam-weights against heavy-weights, but our low-wing loadings saved the day by permitting greater maneuverability. The miracle was wrought, the daylight attacks faded away, but we went from the frying pan into the fire.

The mass night attacks started. In effect, we had dammed up the river at one point only to stand helplessly by, watching it overflow at another. Known scientific facts suggested themselves. On paper at any rate, the night pilot could be given eyes and ears to pick up the enemy; in theory, he could be guided to the approximate position of the enemy; but . . . there followed (and is still proceeding) one of the most terrible ordeals in history.

Other scientific facts were brought to bear by the enemy due to the great length of coast-line at his disposal. Even the amateur wireless man realized the inference. Wireless beams could be projected from points far apart on the occupied coast-line and made to intersect over a given point—a city, a town—so no great navigational skill was necessary. It looked as though we were to be wiped out by a hidden hand, but by God's mercy even this has not prevailed.

Not one person in a million has grasped the full significance of the problems facing us. They haven't been told and they may never be told. It is perhaps as well. The great lack is in heavy-bombers. Every year I look forward more than most to the March number of AERO DIGEST, noting the specifications and performance of your machines. The modern heavy long-range bomber is conspicuous by its absence.

The plane that stands out is the Consolidated B-24. C. G. Grey has been going into raptures over this machine, and

every week, *The Aeroplane* includes an illustration of the *Liberator*. It is an outstanding aeroplane—the best offered to the RAF so far. It has the range, speed and bomb load that is our most urgent necessity. Of course, no aeroplane is perfect; two 2400 hp small frontal area liquid-cooled engines would seem to effect a considerable gain in all round efficiency.

Of our medium bombers, the Martin B-26 looks most impressive. I put the speed at 380 mph; we shall see. It appears that you have had to give up the idea of completely cowling the Double Wasp which is a pity. The fact remains that your radial installations are the cleanest and most workmanlike I have seen. You are also miles ahead in airscrew design with the possible exception of the German V.D.M.

Jerry is the farthest advanced in engine design, in engine alimentation castings, *etc.* The German de-icing methods will make your designers pull wry faces. They are away on rocket-assisted take-off; their wireless equipment is good, their bomber armament is bad, but they appear to have the best self-sealing tanks. Yet with all their world-renowned thoroughness, most of their designs lack something vital.

The Italians are clever engineers. One of their cleverest ideas is that of carrying fighter aircraft inside their biggest bomber, but Italy wilts at every turn when it comes to the supreme test. They don't seem to have much guts. An Italian has said that Musso made his worst mistake when he made Italy a Great Power. There was something utterably contemptible in the way in which the Italians waited and then attacked France as she lay helpless, bleeding and beaten to her knees—her energy spent. If the Germans and French have one thing in common, it is contempt of the Italians.

I was in France and Germany a few years ago. The difference between the two nations staggered me. In Germany everybody was serious, industrious, with no thought of pleasure; even the children were marching. In France there was apathy, inertia. Many sensed what was to come. Some Frenchmen even said frankly, "If Germany attacks, we will be beaten." And beaten they were before the fight even started. It was part of their destiny and they knew it.

We didn't want War: we saw no glory in it. We had all we wanted. Many desired to give back Germany her Colonies, for it seemed only right that she should have them back. But (and it was a big BUT) would she ever be satisfied? To me, it is like the thoughtless mother who crams food into her offspring's mouth every time it starts to cry. Yet, it keeps howling for more. Germany was out for blood. Give her the whole British Empire and you would still leave unsatisfied that lost for blood.

Take the Iron Guard, an offspring of Nazism. What did they do in Rumania? They got the Jews, drove them to one of the slaughter houses, slit their throats over the chopping block in a grotesque imitation of certain Jewish religious rites, then tiring of this sport, beheaded the rest. We have filed a number of cases of the murder of RAF pilots who were descending by parachute. Just another aspect of the "New Order in Europe." The Poles are being reduced. There are a lot of them here where I am. They say that if we don't get a bend on, there will be no Poles left.

Distance lends enchantment to the view. New York is 4000 miles from Berlin—all those miles count towards your security. You see pictures of havoc and destruction, more than we ever do, but they are only pictures. Why should you fight? What will you get out of it? Why should you lend us war material? You may never get repaid. Did we pay you for the last wars? No. So what! Why help us at all? It's not America's war, so why not let the British stew in their own juice? Anglo-American cooperation is growing steadily, relentlessly. With it there is growing an irresistible force. The two English speaking nations are being brought closer together.

The unobtrusive, ordinary people are winning this war. They seldom make the news, yet in their little boats they rescued an army of a third of a million men. When their daily work is over, in the city office, on the farm, they are probably dog tired, but they go on duty for half the night. They never ask themselves what they are going to get out of the war, and yet no sacrifice is too much for them. They *are* England, because they love England with a passionate intensity.

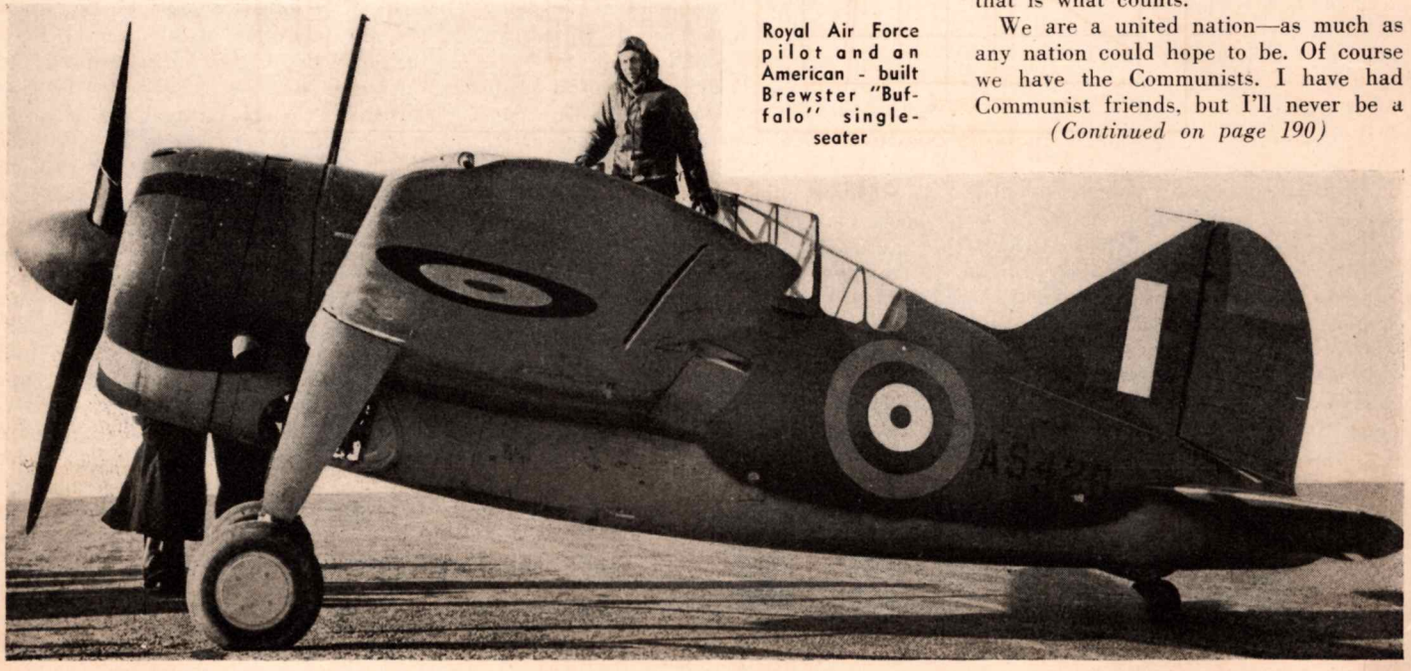
There must be a levelling up. The amenities of 20th century life ought to be available to all. You have a Mercury V8, I have a push-bicycle, in N.Z. I always had a car at my disposal. Ours is a bicycle civilization, and after coming here, especially in London, I prefer a cycle. There isn't enough room to drive a car.

I have always been fairly comfortably off. We had a big farm, and always had something in hand. But millions haven't a ten bob note. In a sense, America has a higher standard, a more equal distribution of wealth than we have, but in Australasia we can run you pretty close. America sets out to serve the people. Churchill has commented on the happiness of the American people. If we can make the people happy and contented, that is what counts.

We are a united nation—as much as any nation could hope to be. Of course we have the Communists. I have had Communist friends, but I'll never be a

(Continued on page 190)

British Combine photo



Royal Air Force pilot and an American - built Brewster "Buffalo" single-seater

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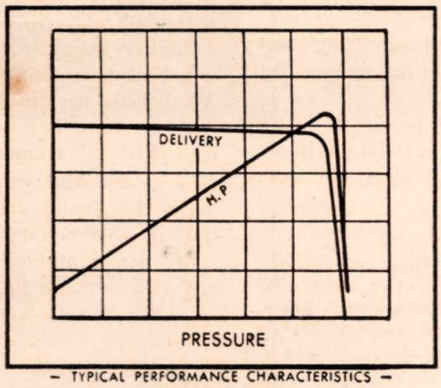

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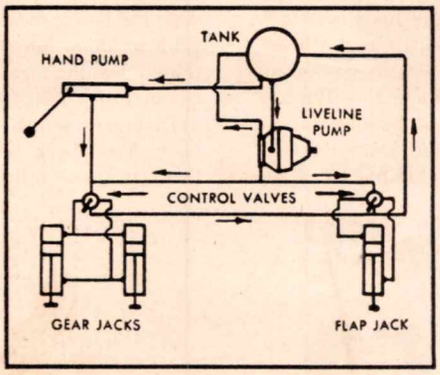

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Delivery at 4000 RPM—4 G.P.M.

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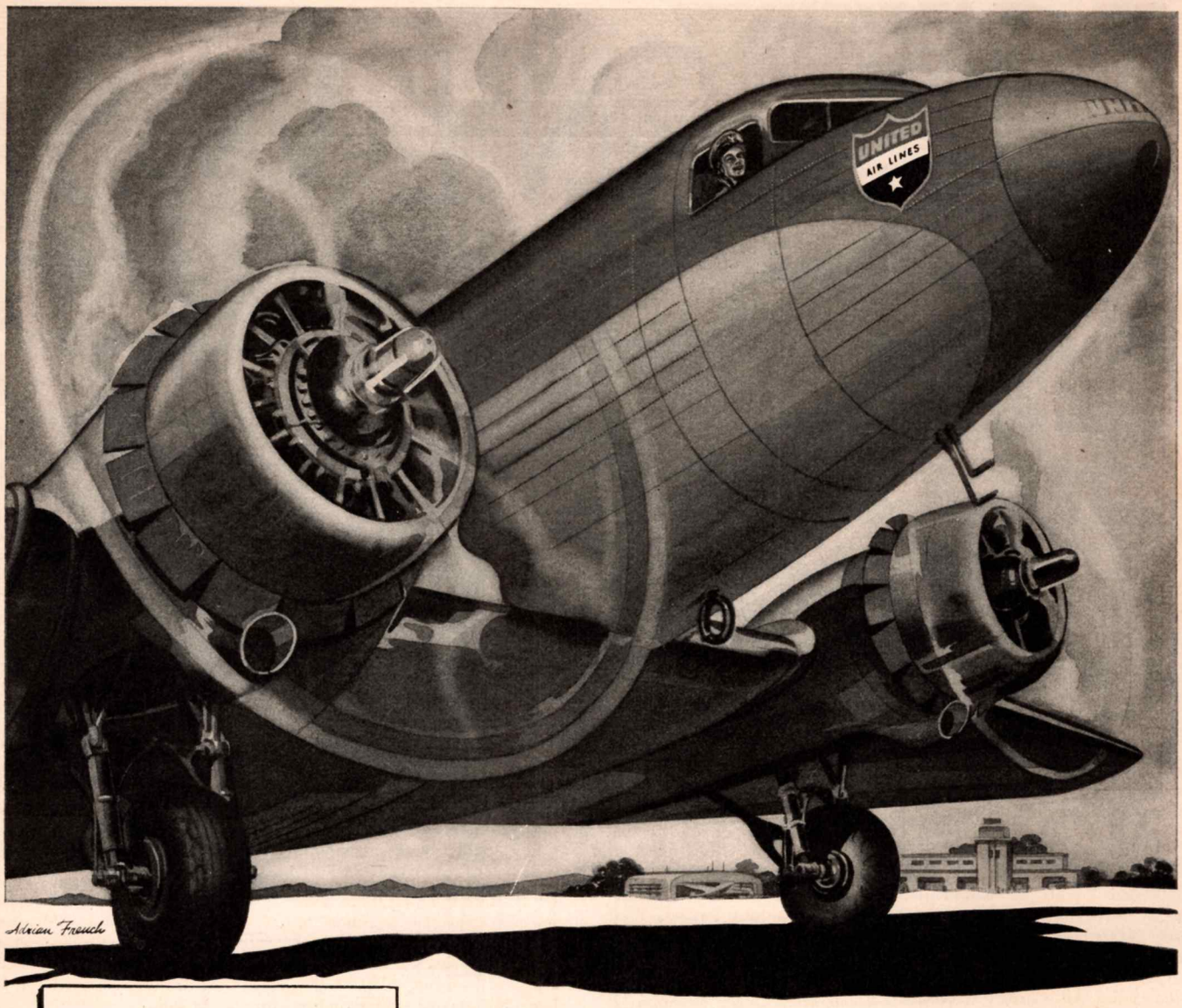

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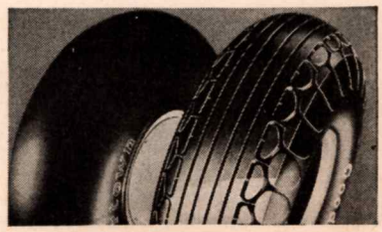

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DIGEST of the NEWS

NEW LEGISLATION ADDS MORE BILLIONS TO INDUSTRY'S BAG

33,000 Aircraft Now on Order for U. S. and Britain—Expansion of Air Corps Spurs Large-Scale Production

As national events last month moved with nerve-tingling alacrity toward an all-out national defense effort, supplemental deficiency appropriations piled up awe-inspiring figures which foretold gigantic commitments for the aircraft industry in the next 18 months. With defense and British aid contracts due to reach more than 40 billion dollars before the 1942 fiscal year is out, a recapitulation at this time indicates more than 6 billion dollars will be earmarked for military aircraft.

Prominent in the 7 billion lend-lease bill and in a 4 billion dollar deficiency bill, were such astronomical items as $2,054,000,000 and $1,343,288,144—all earmarked for aircraft. Major part of the first amount is to provide Britain with 10,700 combat craft, about half of them bombers; the latter amount is for 3000 heavy and medium bombers and 1425 additional combat craft which will be additions to the Army Air Corps proposed 18,000-plane goal.

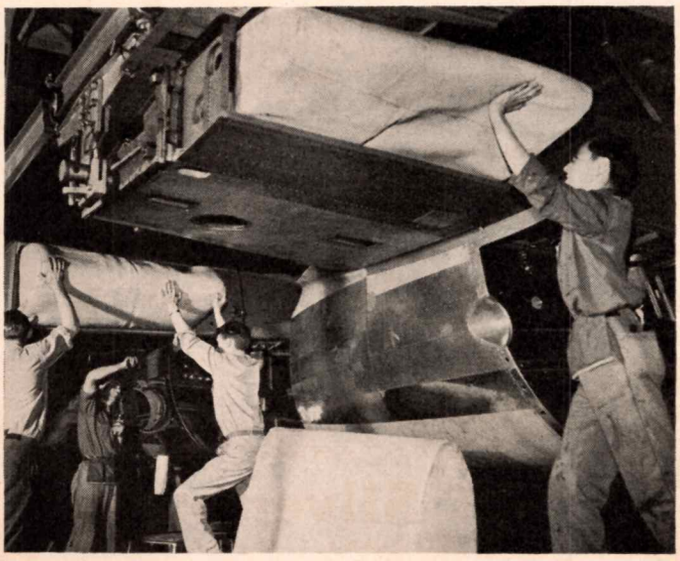
Appropriations and authorizations voted by Congress last summer add another $3,120,000,000 to the totals, but even as the country caught its breath over these stupendous sums, defense officials envisioned 80,000 aircraft for this country and the British by 1943. This would entail further expansions and additional appropriations. Present orders already placed call for 33,000 aircraft—19,000 for this country, 14,000 for the British, not including those under the lend-lease bill.

To man the enlarged air force here, Maj.-Gen. George H. Brett, Chief of Air Corps, told a House subcommittee last month that the Air Corps is aiming at the training of 30,000 pilots a year by 1942. At present, the program is geared to turn out 7200 pilots a year, using 28 primary training schools; the number of these schools will be doubled under the contemplated expansion. Estimates at this time are that the Air Corps will be increased to a personnel of at least 165,000.

Army officials predicted the delivery of military aircraft will begin to reach a maximum next October, but that they will be coming off the production lines "very well" this month and next. Secretary of War Stimson revealed that production remained virtually unchanged in the first quarter of the year, saying output leveled off at about 1000 military craft a month. Actually, 972 planes were produced in February.

Acceleration of production is evident in all quarters. The industry increased its production facilities 28% in the first three months of the year. As of March 1, there were 24,122,230 sq. ft. of production floor area in operation for aircraft, engines, propellers. During the period 27,261 additional shop employees were added to the payrolls, bringing total shop employment to 173,076. Total floor space—productive, engineering, administrative—on March 1, was 31,383,967; and total employment in the industry was 226,172. These figures do not include the automobile companies which expect to add between 100,000 and 200,000 by the time its bomber program gets into full swing. Six companies already are making or are preparing to make fuselages, wings and tail sections. At least four companies have commitments for large-scale production of engines.

Contributing to the nation's economy, the industry is spending three times as much today as it was a year ago. A representative group of 20 manufacturers reported they had made commitments for materials, supplies and parts totaling $37,903,180 in January alone. By mid-summer these purchases are expected to jump to $70,000,000 a month, and expectations at this time are that the industry will spend $750,000,000 during 1941 in such allied industries as rubber, aluminum, machine tools, electrical, paints and lacquers, hydraulics, sheet metal, steel, instruments, hardware, etc.



Self-sealing fuel tanks being installed in attack-bomber wing sections on the Douglas assembly line at Santa Monica

U. S. AIRCRAFT WORLD'S BEST

Meigs Says Their Fire-Power, Armor Equals Europe's Craft

American military planes are the equal, and sometimes superior, to any European-made craft in fire power and armor protection, declared Merrill C. Meigs, chief, Aircraft Branch, Production Division, OPM. The statement, formally issued to the press last month, was designed to refute a speech erroneously attributed to SAE President A. T. Colwell. In the speech Colwell is said to have remarked: "There are no fighting planes planned in the United States which can compete with English or German models for fire power or armor protection."

Pounding his desk Mr. Meigs, former publisher of the Chicago *Herald-Examiner*, said: "Mr. Colwell is either misinformed as to the planes in the process of manufacture or those planned for future protection.

"Planes now coming off the production line both for use here and for the English are the equal of any planes made, in fire power; and they are armored for as great protection as those manufactured in Europe.

"Naturally, detailed information as to present fire power and armor protection, and as to improvements which may be added in the future, are not available to Mr. Colwell, nor to any other person outside the services of the two Governments."

At the same time Director General of OPM William S. Knudsen called Washington correspondents in to make sure that they understood the commercial airlines will receive adequate supplies of engines, propellers, instruments, spare parts and other material required for maintenance of safe and efficient service. The voluntary declaration obviously was called forth by the deluge of communications from those who were worried lest limitations might endanger those who use the airlines. Knudsen also had received many strong intima-

tions from the Hill that the policy, if it were in existence, might be closely scrutinized in impending Congressional investigations. Said Knudsen:

"The question has arisen about the tendency of military aircraft needs to lower the efficiency of American airlines, which has been the greatest in the world.

"The military airplane program is of paramount importance in the National Defense. But we deem it a matter of fundamental policy, inherent in any consideration of civilian aircraft priorities, that the airlines shall continue to receive delivery of engines, propellers, instruments, spare parts and material, necessary for maintenance and overhauling operations.

"During 1940 our airlines received new airplanes in a number sufficient to replace obsolete planes, and to make all essential replacements, and to prevent any interruption in scheduled operations.

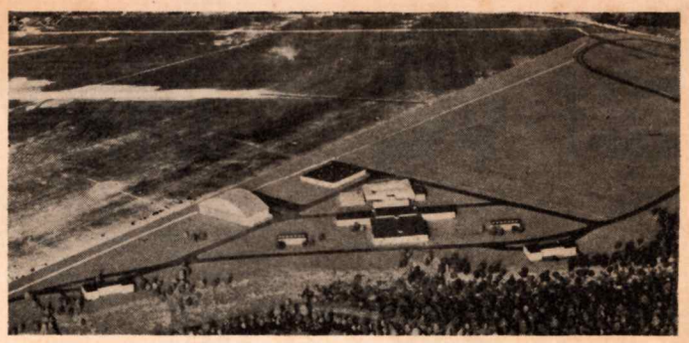
"Mark I am speaking of domestic airlines. They are now at the highest state of efficiency, with the greatest capacity in the history of air transportation in America, and this capacity and efficiency is now on a scale never approached as to quality or coverage in any other country in the world.

"I wish most emphatically to declare the OPM, the Army, the Navy, and all other agencies and officials of this Government are convinced of the necessity of maintaining this existing quality of air transportation.

"Also, I wish to underscore this statement: less than 3% of the pilots or captains, and less than 8% of the co-pilots or first officers among airline pilots and co-pilots, who are military reservists, have been called for military service: and when they have been called, replacements have been ready."

4813 CPT Students In Military Service

Army and Navy on March 1 had accepted 4813 graduates of CAA CPTP, and 914 flight instructors trained in CPTP had been fed to other aviation activities. The 4813 represent 11% of the students who have completed the CPTP preliminary course, and approximately 25% of the total number trained in the secondary phase. Twenty percent of the Army's January class were CPTP trainees. Of 941 flight instructors trained in the CAA program, 468 are now giving flight instruction in the Army's primary civilian training centers, 27 are teaching Naval aviation, 117 are in Canadian flight centers, 96 are on active duty with the Army, 26 with the Navy, and 206 have gone to airlines to train as replacements of older co-pilot personnel. On March 1, 37,277 pilots had been trained in CPTP student courses, 3911 in the secondary phase. A total of 2063 instructors had been given refresher courses.



Model of the proposed layout of the NACA's third major research station to be built at Cleveland Municipal Airport

SAE Meeting Features Diversified Program

Twelve papers were read at the SAE's National Aeronautic Meeting, held at the Washington Hotel, in Washington, March 13 and 14. President A. T. Colwell opened the conference by discussing the world's production of mechanized military equipment. He said he had spent several months in Germany before the War, and declared Germany is the only place where there has been standardization on a large scale. Colwell asserted we are catching up with them and will do a better job than they have ever attempted.

Colwell said our aviation industry today is where the automobile industry was 20 years ago. He declared our new designs, by the end of this year, will be the best in the world, and they will begin to roll out in astonishing quantities. In his opinion the air war in the immediate future will be fought at altitudes of 40,000 ft. He said battles today average 25,000 to 30,000 ft., with the pilots aided by oxygen. He expects planes with ceiling of 40,000 to 50,000 ft. soon.

A sharp drop in German plane production in the last few months indicated retooling for new models, he said, and predicted there would be a new 400 mph German Focke-Wulfe fighter with a 2000 hp double Daimler Benz 600 A engine. He predicted a new Heinkel 119 bomber and new Messerschmidt fighter, both with two double DB motors. He thinks American production of combat planes will equal German output twelve months hence, giving us air superiority.

A new "compound" engine, using high pressure and low-pressure cylinders, acting as compressor as well as working cylinder, was described by Ford L. Prescott, senior mechanical engineer, power plant laboratory, Army Air Corps Materiel Division, Wright Field. Increased use of fully automatic carburetors in aircraft was the subject of a paper by M. J. Kittler, chief engineer, aircraft division, Holley Carburetor Co. Research in internal combustion phenomena of internal combustion engines was discussed by Dr. Ernest F. Flock, Bureau of Standards. Richard C. Gazley, designing engineer, Bell Aircraft Co., led the discussion of propeller problems. Ralph S. White, CAA, implored airplane engine manufacturers to eliminate motor and propeller noises. He branded as a "myth" the claim that such noises cannot be abolished. He asked for a drive to coordinate efforts for air safety.

Thomas B. Rhines, Hamilton Standard Propellers Div., United Aircraft Corp., declared increasing engine output plus increasing propeller diameter may have to be

(Continued on page 90)

Bellanca "Cruisair" bought by Lycoming for use as flying laboratory to test its higher horsepowered engines

1000 Expected at Southwest Conference

J. Howard Wilcox, executive secretary, has just reported that almost 1000 persons may gather at Wichita on April 24 to 26 to attend the Southwest Aviation Conference.

Held concurrently with the city's celebration of Wichita Aviation Week, the conference offers an exceptional program of events, highlighted by the attendance of an impressive group of aviation leaders many of whom are scheduled to talk on their specialty.

William Knudsen, General H. H. Arnold, and Admiral Towers have been invited, but if they should be unable to attend, arrangements have been completed to bring their addresses to Wichita *via* remote control telephone hook-up. Invitations also have been extended to representatives of Latin American republics.

Theme of the Conference, is Southwest Aviation now and after the defense program. Topics included in the agenda also cover feeder lines, national defense development, CPTP, small town airports and landing strips, airways markers, *etc.*

The conference area covers the states of Colorado, Kansas, Missouri, New Mexico, Oklahoma, Arkansas, Texas and Louisiana. Conference officers include W. G. Skelly (Spartan) as president; C. R. Mooney (NATA), secretary; and R. J. Smith (Braniff) vice-president. Chas. A. Smoot is general chairman.

Wright Employees Present Two Engines to British

Two 1600 hp Cyclone engines were added to the defense of Great Britain recently when approximately 15,000 employees and friends of Wright Aeronautical Corp. gave them to a representative of the Bristol Aeroplane Co. of Great Britain. The engines were purchased with funds obtained during a "Bucks-for-Britain" campaign.

M. F. Gemme, Wright assembly superintendent, presented the engines to the Right Honorable Lord Marley, of London, England, who represented Bob Williams, oldest worker of the Bristol organization. The latter had been chosen as the British recipient.

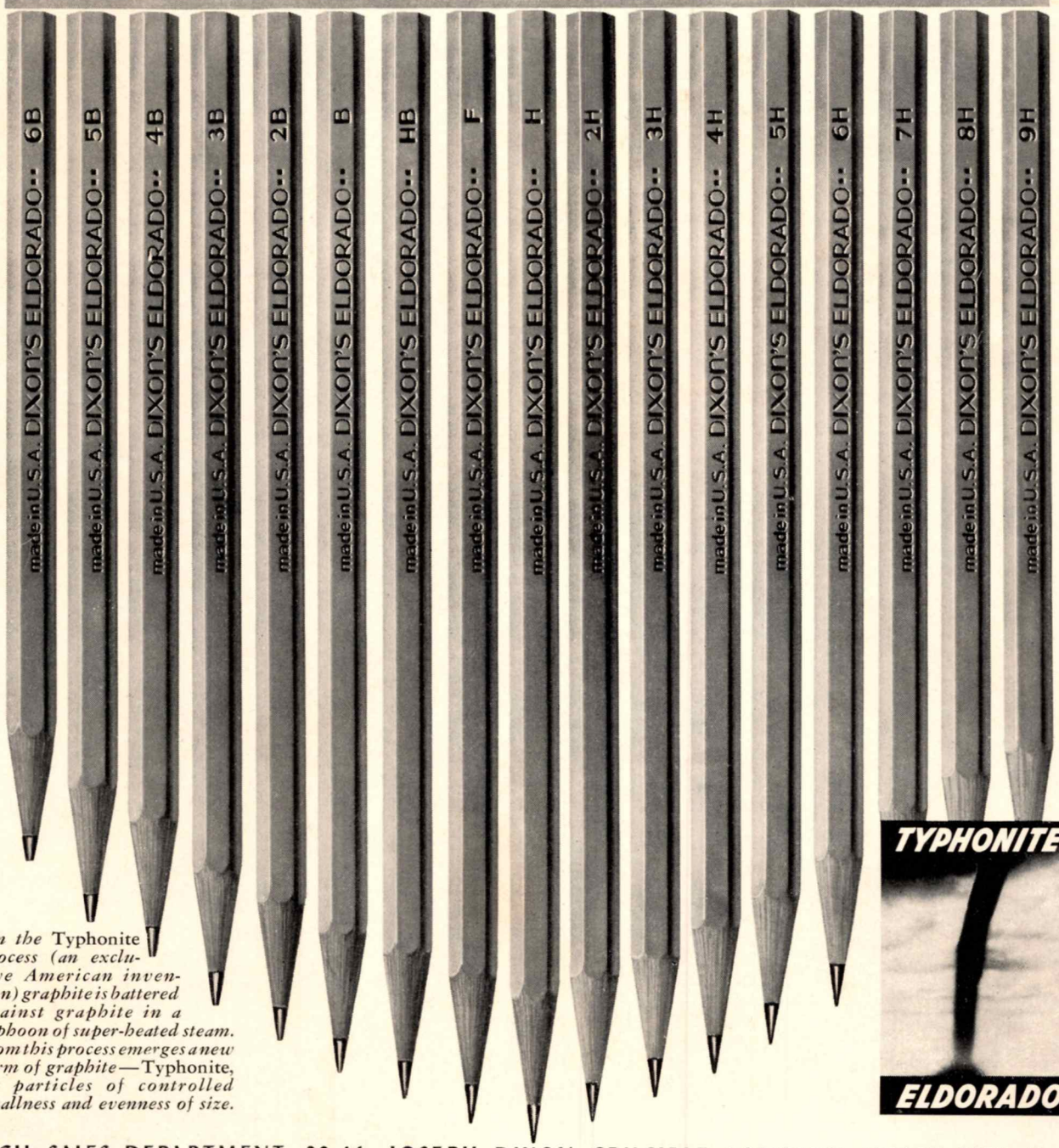
Rearwin Building Trainer For Pan American Airways

First of a new type, tandem instrument training plane being produced for Pan American Airways will soon be ready for test flights, according to Kenneth Rearwin, vice-president of Rearwin Air-

(Continued on page 71)

America Preferred

American workmanship, methods and materials have produced a pencil that declares the American artist's permanent independence of foreign supply. Product of **Typhonite*, the finest dry lubricant known to science, Eldorado pencils are second to none in uniformity, strength and smoothness of leads whose opaque lines produce the perfect blueprint. We cordially invite artists, architects, designers, engineers and draftsmen to compare Dixon's *Typhonite* Eldorado pencils with the finest Europe ever produced.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TYPHONITE
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**In the* Typhonite *process (an exclusive American invention) graphite is battered against graphite in a typhoon of super-heated steam. From this process emerges a new form of graphite*—Typhonite, *its particles of controlled smallness and evenness of size.*

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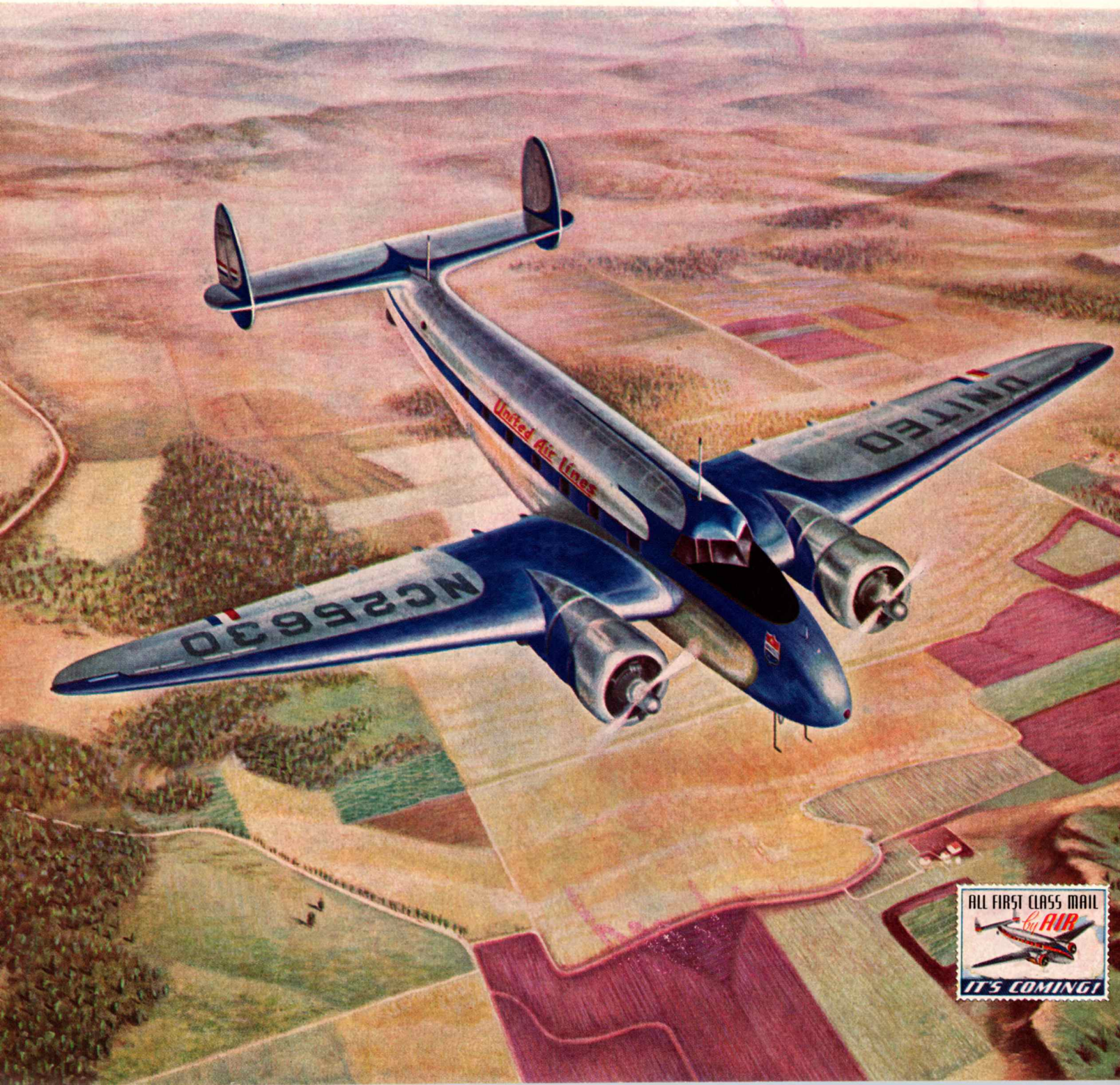
THE *Lockheed* LOG

LEADERSHIP



in performance!

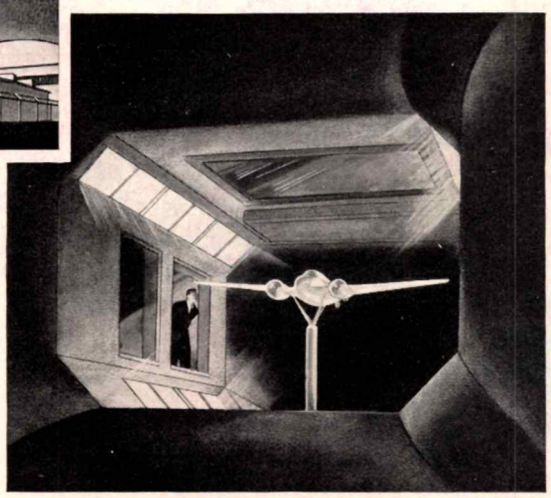
"Performance" designates the flying characteristics of an airplane. But one word is inadequate to put across what we mean when we speak of Lockheed performance. One word can't tell how Lockheed Lodestars save time and money for airline operators by cutting flying schedules... stepping up operations!

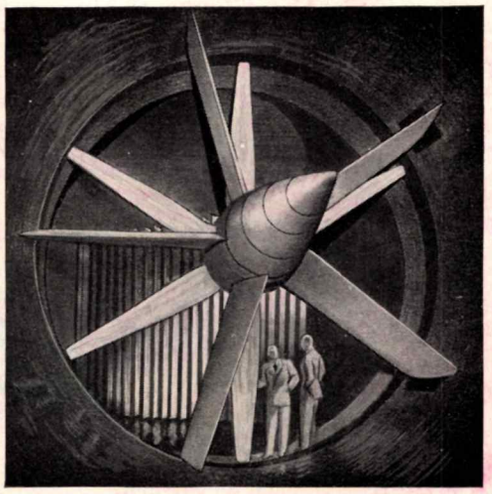
One word can't portray the speed, the agile maneuverability and the staying qualities of the Lockheed "Lightning," known in military circles as the P-38 Interceptor Pursuit! One word doesn't clearly picture the successes of Lockheed "Hudson" bombers against superior numbers of pursuit airplanes in the defense of Britain. *One* word can't do all that... but Lockheed's *record of performance* can speak for itself!

THE TEST SECTION is most important. Here the size has been reduced from 20′ x 30′ to 8′ x 12′, stepping wind velocities up to 275 m.p.h. Models 10′ wide can be tested to simulate every flying attitude. The results of these tests are electrically recorded for further study.

A 20′, SIX BLADE PROPELLER develops Lockheed's high wind velocities. It is gear driven through a magnetic clutch by a 1750 h. p. electric motor. Note water-cooled vanes which guide air around corners with negligible loss of speed and, at the same time, keep air temperatures down for efficient operation.

To provide "housing for a hurricane" was another problem solved by Lockheed engineers in their quest for highest performance. Their answer was this 170′ x 70′ aerodynamics laboratory... largest and fastest privately owned wind tunnel in the world. Its daily operation shortens time between plans and production by a minimum of five months.





LOOK TO *Lockheed* FOR LEADERSHIP

LOCKHEED AIRCRAFT CORPORATION, BURBANK, CALIFORNIA, U.S.A.

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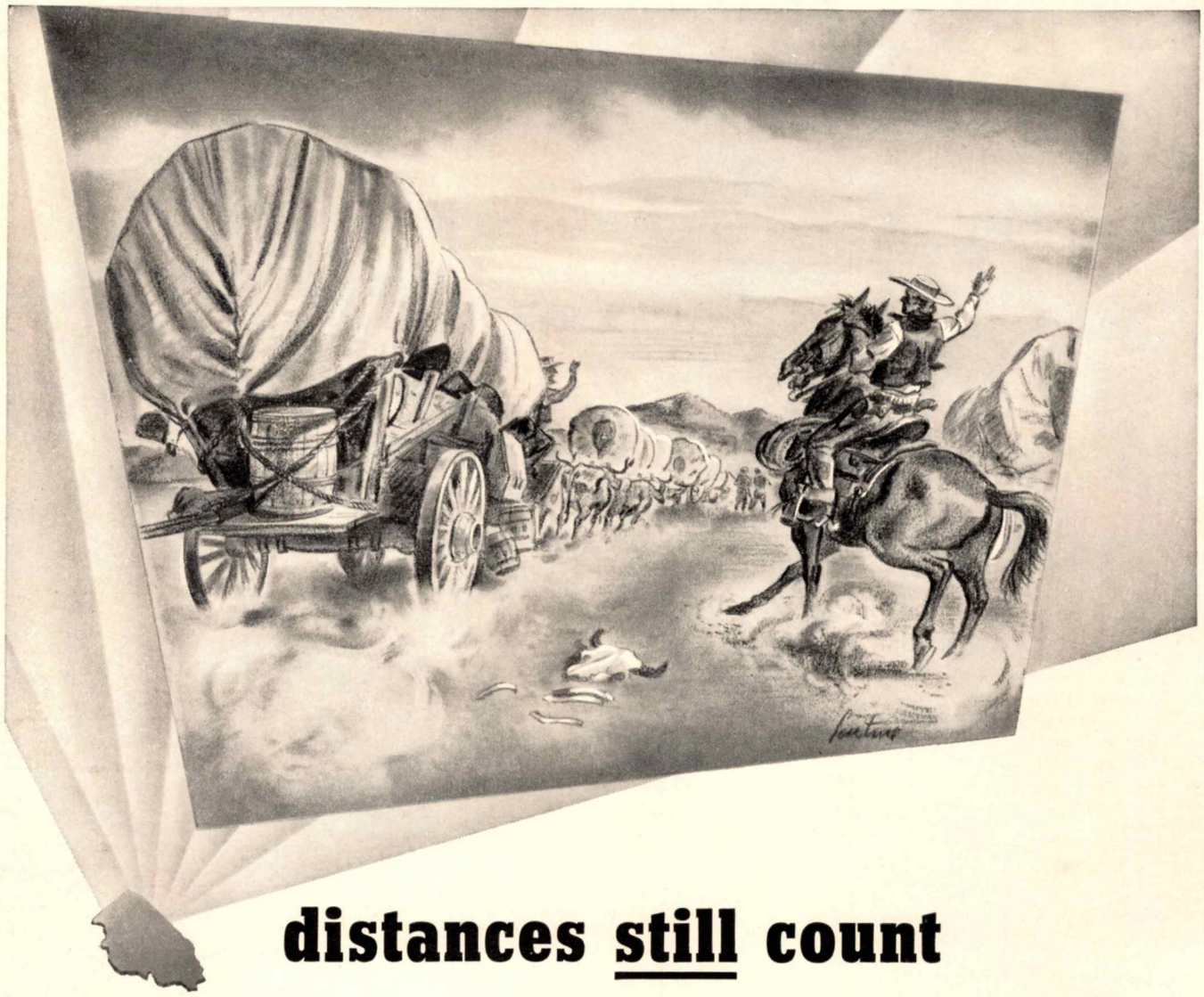


distances still count

It is a far cry from the creaking, lumbering conestoga wagon to the sleek smooth-riding aircraft of today. In terms of time, distances have shrunk almost, but not quite, to the point of becoming inconsequential. Despite the speed with which ground can be covered, *distances still count* in the production of aircraft as they do in the manufacture of every commodity.

Distances count in terms of proximity of raw materials, of tools, of accessories, and of parts. *Distances count* when you consider accessibility of the markets of the Nation. *Distances count* in the important consideration of a location less vulnerable to interrupted production by unforeseen events of the future.

Authorities agree that in these factors *distances still count*, and where distances count, the State of Illinois occupies a favored position in industry.

INVESTIGATE THE ADVANTAGES OF AN ILLINOIS LOCATION. Check ALL the advantages Illinois offers to manufacturers of Aircraft and Aircraft Parts, Accessories and Tools. Write the Illinois Development Council, at Springfield, for a special report containing detailed facts on production factors which are especially advantageous in Illinois—a report containing data on raw materials, labor, power, fuel, equipment, taxes, transportation, markets, and available plant sites.

Please list any special or unusual requirements in production or distribution, in order that a truly practical and informative report may be submitted for your consideration. Your inquiry will, of course, be kept strictly confidential. Write—

ILLINOIS DEVELOPMENT COUNCIL
STATE HOUSE • SPRINGFIELD, ILLINOIS

ILLINOIS

THE STATE OF BALANCED ADVANTAGES

(Continued from page 66)

craft and Engines, Inc. The trainers will be used by the airline to train their pilots in instrument flying, according to Mr. Rearwin.

The trainers are being built as a new version of the Rearwin *Cloudster*, a 120 hp plane with a 35-ft. wing span, an overall length of nearly 22 ft., and a cruising speed of 120 mph.

New Plane Ready Soon

Interstate Aircraft & Engineering Corp., El Segundo, Calif., will soon announce a new side-by-side, two-place plane, according to Don P. Smith, President.

The new plane, a companion model to the Interstate *Cadet*, civilian training plane designed to CAA specifications, has been named the *Privateer*, and will introduce many unusual features.

Menasco Extends Shifts

In a move to step-up production and overcome a shortage of skilled workers, Menasco Manufacturing Co., last month placed its engine and hydraulic strut division in Burbank on two 10-hour shifts per day, five days per week.

A. E. Shelton, president, in making the announcement said that under the new arrangement it would be possible to get maximum productive efficiency from the available manpower, and that he expected the daily production of engines, by April 1, to reach four per day, plus spare parts for one complete engine. Output was three per day before.

The company during recent weeks has been running three 8-hour shifts, with only sufficient skilled men available, however, for a skeleton crew on the third shift.

Advisory Service Formed

Organization of a new aeronautical advisory service was announced in New York by the G. M. & L. Henig Co., 80 Wall St. Headed by L. Henig, well known aeronautical engineer, and "Boen" Hartsinck, for many years representative of the Dutch Airlines (KLM) in the United States, the company will specialize in problems of the smaller manufacturers, now receiving defense contracts for airplane parts and equipment, and handling purchases and technical representation for foreign users of American equipment. *(See photograph page 89.)*

New Boeing Clipper Nears Delivery

First of Pan American Airways' new fleet of six Boeing Clippers, which will make possible daily-except-Sunday service across the Atlantic in the immediate future, was lowered into launching position at the Boeing plant last month, substantially completed and soon to be ready for flight.

Moving of the first clipper to the water's edge on Boeing's launching ramp was accompanied by moving Clipper Number Two from its construction jig in the factory to the outer dock immediately behind the first ship. There it will be made ready for flight soon after the first one.

Present plans call for delivery of one ship a month.

Underwriters Expand Again

Associated Aviation Underwriters has opened a new branch office in Dallas, according to Daniel deR. M. Scarritt, manager. This is the second new office that Associated has opened within six months.

Prior to opening the Dallas office, William W. Walter in charge of field production for the underwriting group, spent two months in the Southwest surveying the market and determining the location of the new office. Walter will be in charge of the Dallas office which is located in the Magnolia Building.

Changes Name of Subsidiary

Randolph C. Walker, president of Aircraft Accessories Corp., announced a change in the name of the company's wholly-owned subsidiary in Kansas City. Formerly known as the Thos. L. Siebenthaler Manufacturing Co., the subsidiary's new title is Aircraft Accessories Corporation of Missouri.

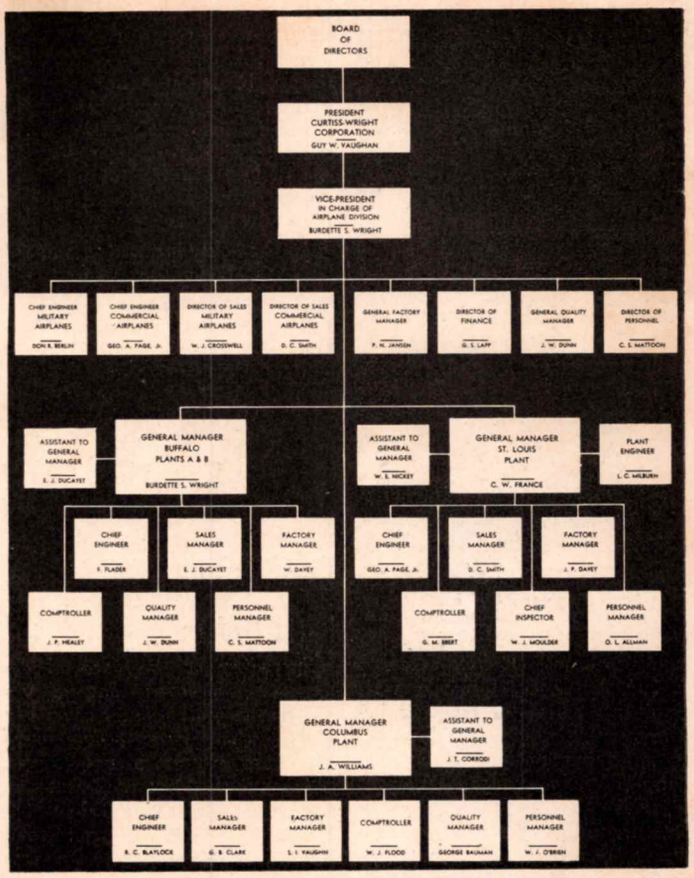
According to Walker, the change was made in order to more clearly identify the subsidiary with the parent company.

Donald M. Stoner will continue as vice-president and general manager of the subsidiary, with Walker holding the position of president. Other officers are James A. Habegger, treasurer; and William J. Hosmer, secretary.

1875 Aircraft from U. S. Shipped to Britain

Reports from London last month recorded the fact that 1875 aircraft of American manufacturers were shipped to Britain during 1940, compared with 300 in 1939. Evidence of a growing output in this country of aircraft manufactured for the British war effort is seen in the report that of the total number shipped during the year, about 1600 of the aircraft were delivered between July and December.

January exports to Britain totaled 419 aircraft, according to the Aeronautical Chamber of Commerce which said that exports to Britain in December totaled 320. Engine exports to Britain during the month attained a total of 305 units, not including 135 which were shipped to Canada and smaller numbers which went to other British Empire components.



Organization chart of the Curtiss-Wright Corporation

Expansions

To speed service to aircraft companies on the West Coast, Rohm & Haas Co., Philadelphia, is building a branch plant in the Los Angeles area, scheduled to begin operation May 1. The new building will be devoted primarily to fabrication of Plexiglas sheets into cockpit enclosures, observation turrets, and similar transparent plastic aircraft parts.

The new plant is the latest step in an expansion program which Rohm & Haas has undertaken to keep pace with the increased consumption of its plastic products. Its main plants are located at Bristol, Pa., and Bridesburg, Philadelphia, Pa., where in addition to plastics it manufactures organic and inorganic chemicals including products widely used by the leather, textile, paper, insecticide and other industries.

* * *

Expansion of already greatly enlarged manufacturing facilities in order to handle new orders was announced by Maj. Henry R. Mallory, president of Pioneer Parachute Co., Inc., an affiliate of Cheney Brothers, silk manufacturers of Manchester, Conn. This additional space is required to take care of orders already placed and in anticipation of new orders.

Demands for parachutes have increased to an extent that it was necessary to increase production from a weekly output of 50 'chutes last year to a present production of 500 a week. This requires more than 1,500,000 square yards of silk parachute fabric per year, in addition to 10,000,000 feet of silk cords for suspension lines. These are being made at the Cheney mills.

The Macwhyte Co., Kenosha, Wis., is erecting a 50 × 100 ft. addition to its aircraft department to keep pace with increased demands from manufacturers.

Douglas Personnel Shifted To Speed Output

Promotions and re-assignments of executive duties in connection with the accelerated production were made last month by Douglas Aircraft Co.

The new management includes appointment of five councils designed to coordinate and improve control of Douglas activities and the creation of a new office responsible for inspection and quality of all Douglas products and plants in the United States.

Under the new arrangements

One of the 96" wheels on the new Douglas B-19 bomber

and promotions, the following changes become effective at once:

Carl A. Cover, formerly vice-president and general manager, becomes executive vice-president and the top ranking official of the company directly under President Douglas.

George A. Strompl, factory manager who shaped and directed organization of the Long Beach plant, becomes Director of Inspection Standards in all plants and for all products. This post will give him wide powers and responsibilities in production of airplanes and subassemblies in Santa Monica, El Segundo and Long Beach, Calif., Tulsa, Okla., and in the Detroit area, where more than $100,000,000 worth of contracts have been placed by the Douglas company.

H. D. Houghton assumes the post at Long Beach made vacant by Strompl's promotion; George R. Tulloch becomes assistant manager, and H. E. McCann is named superintendent of the Long Beach plant.

G. A. Huggins becomes Director of Tooling for the company and will be charged with the duty of coordinating all tooling problems in all Douglas plants.

The five new management groupings announced by Mr. Douglas will make possible improved coordination of production in the four Douglas plants and more equitable distribution of the manifold and constantly increasing duties formerly imposed on the general manager.

Elections

Bellanca Aircraft Corp. reorganized last month, and elected Joseph S. Wilson, Wilmington attorney, as its president, while G. M. Bellanca, who held the presidency before, was elected chairman of the board of directors and consulting engineer. Others in the reorganized company include: A. Felix duPont, Jr., J. B. Jessup, R. D. Morgan, J. B. B. Parker, directors; and James R. Morford, secretary and general counsel; W. R. Yarnall, treasurer; and H. L. Thompson, assistant secretary.

* * *

At an election of officers of Roosevelt Field, Inc., Grover Loening was reelected chairman of the board; and W. D. Guthrie was renamed president, treasurer and general manager.

* * *

J. T. Mascuch was elected president-treasurer of Breeze Corporations, Inc., at the annual meeting of the corporation. Other officers elected include: J. P. Lucas, vice-president and secretary; A. Langstaff Johnston, Jr., vice-president, and Emile L. Beh, vice-president.

Parts Orders

Spreading of the national defense appropriations among subcontractors took another spurt last month when large orders were placed by aircraft manufacturers.

Among the sizeable contracts was one for $5,000,000 which Hayes Manufacturing Corp., Grand Rapids, received from Brewster Aeronautical Corp. This order calls for the construction of outer wing panels, spares and other parts for the Brewster 340 dive-bomber soon to go into production.

Another large order to subcontractors was placed by Republic Aviation Corp. which let $2,831,000 worth of business to more than 48 manufacturers located throughout the country. This business is for various parts and materials for a new high altitude pursuit which Republic is to build for the Air Corps under a $62,000,000 contract.

Also reflecting the increasing subcontract business now being let, Ryan Aeronautical Co. reported last month that it had received orders for exhaust manifold systems in the past few weeks totaling $1,350,000. These orders were placed by several aircraft manufacturers, and brings the company's backlog in its contract manufacturing division to its highest peak.

Get Group Insurance

McCauley Steel Propeller Co., Dayton, has adopted a group program which provides four-way security for its employees in the form of life insurance exceeding $90,000, sickness and accident, hospital expense, and surgical operation benefits. Announcement of the plan was made by Ernest G. McCauley, president of the company.

The group program is being underwritten by the Metropolitan Life Insurance Co.

AT THE AIRPORTS

Vail Field Now Operating

Vail Field, Los Angeles, is now operating under the management of United Flying Schools of America, Inc., and will become the center of the school's flight training program and other schools, as well as serving as a public airport, catering primarily to private plane owners. New runways, taxi strips, and hangar have been constructed and complete hangaring, servicing and repair facilities is available. An advanced CAA flight training program is now being given by UFSA, using Waco YPT-14 trainers. Additional planes are available for student training. All flight instruction is supervised by Capt. Lowell P. Lamoreaux, former chief pilot at Hancock Field.

Improvements

Cheyenne, Wyo., city officials have purchased 20 acres of land adjoining the municipal airport to provide for extension of runways including the construction of a 5200-ft. runway.

* * *

Extension of the runways at the Madison, Wis., airport under a $218,000 WPA grant will get underway this fall. The extensions will utilize all the remaining land available for runways.

* * *

The Four Lakes Aviation Co., Madison, Wis., has leased the airport at Whitewater, Wis., and has constructed 2400-ft. runways there. The Four Lakes firm has purchased the hangar and plans to build an office and repair shop. Keith Harms is manager of the port.

Texas Projects

Announcement was made that extensive improvements to the Palestin, Tex., municipal airport are in progress under the direction of the city council, and that the steel hangar has been renovated and repainted, the field leveled and otherwise improved.

* * *

Plans for a $250,000 airport at Nacogdoches, have been submitted to the CAA in Ft. Worth, with immediate approval in prospect. Approximately $7000 will be used by the city to purchase a farm 4 miles from the city as the site for the new airport. Meanwhile, repairs have been made on the city's old airport and temporary hangars erected to serve present needs.

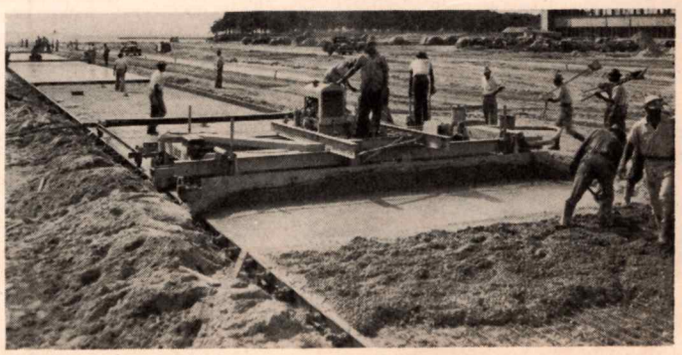
500 Hired for Gravelly

Upwards of 500 new employees are being recruited for Gravelly Point airport at the Capital. The new offices at the Terminal Building open early this month and will house some CAA workers. Federal workers will be augmented by employees of the airlines. Pennsylvania-Central Airlines has announced it will move its maintenance shops and general offices there from Pittsburgh.

Military Field Expansion

Site for a proposed Army primary training school at Vernon, Tex., has been tentatively selected by Capt. J. E. Smart. Commitment of the site will be given business men in Shreveport, La. for operation of the school if the approval of the War Department is obtained. The group is headed by John D. Lyle.

The site under consideration is located six miles southwest of Vernon, and if Washington approves the contract, Lyle and his associates will build $25,000 worth of buildings. The city will vote on a bond issue to finance purchase and installation of utilities.



Blaw-Knox gas-driven finishers working on a 20-ft. wide paving slab for runways at the Jacksonville Naval Air Station

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WASHINGTONIA

ARNOLD KRUCKMAN

Industry Faces 6 Billion Backlog

The Lend-Lease Law carries a cash allocation of $2,054,000,000 for planes, engines, spare parts and accessories. When this sum is added to the cash and authorizations already validated for the Army and Navy, totalling $3,487,852,000, you have a grand total of $5,541,852,000 to be put to work in aircraft factories by the end of June, 1942.

There will unquestionably be other appropriations for the fiscal year 1942; and other appropriations and allocations for aircraft and aircraft supplies are scattered through bills for the benefit of other agencies of the Government. It is generally assumed here that these undefined items will roughly total another $500,000,000. The gross total either already in process of being expended or, mainly, to be spent with the American aeronautical industry the next 15 months, patently aggregates roughly $6,000,000,000. It certainly is incontrovertible that $6,000,000,000 is a stupefying quantum in any place and in any circumstance. It obviously means that we have not even struck our gait in expanding plants and in throwing the industry of producing aircraft into gear. The staggering impact of these $6,000,000,000 rather leaves you gasping in an effort to imagine what it implies.

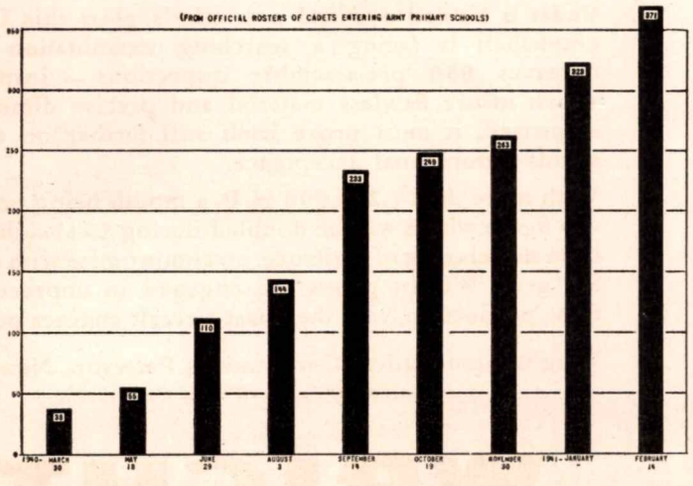
Assuming that the factories are built and equipped with necessary machinery there is the problem of labor. The other day the U. S. Bureau of Labor Statistics issued an estimate that plane manufacturers will need a minimum of 555,000 additional "men" before September, 1941. The statement declared that on January 1, 1941, the total backlog of unfilled orders in aircraft industries totalled roughly $4,000,000,000. Last December they employed 200,000 workers. The most conservative estimate in Government agencies is that they will need a million workers early in 1942. The problem, of course, is where to get them.

Training More Workers

Paul V. McNutt together with "Doc" Studebaker are feverishly training 3,000,000 persons, men and women, in vocational schools in 300 cities, most of the schools operating on a 24-hour schedule. They are trying to turn out a supply of every skill the human mind can conjure for the needs of national defense. But apparently there is much uncertainty about the ultimate usefulness of some of these hastily trained hands. Last month, OPM called a conference of the country's leading industrialists and labor leaders to devise some means of producing more skilled workers. It was suggested that they follow the British method of in-plant training, taking girls and boys as young as 16. There was even a hint that labor conscription might be invoked if something does not happen to break this bottleneck.

There are some who do not have warm sympathy with the tearful pleas that come from the Labor Department and similar agencies. CAB Member Oswald Ryan particularly recalls the effort that started some years ago to induce several Government agencies to prepare for the need of skilled workers. Ryan was a member of the Interdepartmental Committee which made an exhaustive study and reported to the President. The imminent shortage was realized, and the Government was urged to spur the training of skilled workers. The report was cautiously phrased, but there were those who were so afraid of Labor that the report was given the hush-hush treatment, and apparently was allowed to die of anemia.

There has long been an Apprentice Training Division in the Department of Labor. If it acted, the trail has become dim. Organized labor was opposed to any additional trained workers. It pointed out that thousands of its members worked only part time, and other thousands had little or no work. And it met the Army and Navy urgency for possible skilled workers by suggesting that roundly trained machinists and artisans were no longer necessary. They said specialized workmen, skilled in one or two particular specific details of line production, could be trained quickly. The Union people here utterly opposed more apprentice trainees. Of course, now they acknowledge the lack of skilled workers. They suggest that new industries are responsible for absorbing them, that the draft is taking them, that the WPA gets some because it pays a higher hour rate in some instances, and most particularly they urge that higher wages are the most pressing need. They say that aircraft workers especially must receive more pay. They claim aircraft workers are paid less than workers in automobile industries for similar skills. The stress on the need for higher wages is so insistent, and the suggestion of inevitable strikes is so persistent, that one wonders if some of this general program is the long-range technique to hoist the wage scale.



Official rosters of cadets entering Army primary schools show that the Air Corps is getting more than 50 cadets a week from the CPT

Standardization Nears

Meanwhile, there are unmistakable signs that in the aircraft industry comprehensive standardization of parts, machines and methods is practically here. It is the result of months of conferences. Changes and adjustments already are quietly getting under way in shops and plants. They say the interchange between plants will simplify servicing of aircraft under wartime needs. They seem to be confident that every phase of production will feel the effect. There is a feeling that without much sacrifice of important machinery many of the thousands of airplane parts may be simplified for standard uses. However, they tell you the airplane industry still will have to carry the producing load alone for another year. It apparently is assumed it will take the automobile people at least a year to get into gear in producing parts.

Defense Agencies

Commerce Department is a "defense agency," giving it a special status of preferment, since its workers and works are particularly needed in defense activities. This means the CAA-CAB may employ emergency personnel without waiting for Civil Service red tape. It also means that CAA-CAB personnel may be exempted from military and other special services.

There are some 80 such "defense" agencies in the Federal Government. If necessary, their activities also might be covered by the blanket of hush-hush that may be pulled over the military services. But Congress does not appear to respect the implications of the status. The House Appropriations Committee quizzed CAA-CAB people about the influence of Commerce officials on CAA-CAB affairs, and about the money it was promised would be saved when CAA was reorganized. The Committee particularly is curious about the fact that there is no organization chart available, and the Committeemen would like to know why practically every officer rates as a temporary "Acting" this or that.

The people on the Hill have heard that the reorganization impending, after FDR gets authority from Congress, will cut the Gordian knot of the CAA-CAB by making it part of an entirely new general agency. The purpose is said to be to create a general transportation authority. The idea is not exactly new. During the past two or three years several bills have been offered to accomplish this objective. They say at the Capitol that the President plans to make the proposed Federal Transportation Authority the roof for Inland Waterways, Interstate Commerce Commission, U. S. Maritime Commission, CAA-CAB, and probably the Federal Communications Commission, the Weather Bureau, and similar agencies. The railroads have desired to achieve this goal ever since the airlines began to become a serious competitor.

Investigations Pending

CAA-CAB apparently will also have a careful combing by the Committees which are investigating the recent epidemic of airplane accidents. Sen. Clark's Committee employed Lt. Carl Brown Harper (USN), retired, to make the technical investigation. The House Committee headed by Chair-

(Continued on following page)

An Eye to Perfection

Before a Wright Engine is assembled, nearly 45,000 mechanical inspections of the separate parts assure unvarying quality.

Under a trained eye and a jeweler's glass this Cyclone crankshaft is facing a searching examination which climaxes 850 pre-assembly inspections — inspections which insure flawless material and precise dimensions. Approved, it must prove itself still further on the test stands before final acceptance.

With more than 1,200,000 H. P. a month being produced — a figure which will be doubled during 1941 — there has been no relaxing of vigilance, no compromise with quality. Six great Wright plants are engaged in unprecedented mass production ... of the finest aircraft engines possible.

Wright Aeronautical Corporation, Paterson, New Jersey
A Division of Curtiss-Wright Corporation

WRIGHT
Aircraft **ENGINES**

(Continued from preceding page)
man Nichols, Oklahoma, will hold hearings at St. Louis, Cincinnati, Chicago, Salt Lake City, Lovettsville (Va.), and at Atlanta. Its instructions are to investigate flying conditions, ground equipment, facilities, management, operation, administration, supervision, legal administration, regulations, inspection, safety equipment, airline liability for loss of life and injury to person and property. Both Committees hold that an average of one major crash a month is beyond coincidence. Meanwhile, the CAA-CAB for its own purposes is also making a thorough investigation. It has sent out ten of its best inspectors who will rove over every part of airline United States for 90 days to survey all airlines, airports, equipment, CAA-CAB employees, pilots and others involved in air transport.

Assistant Secretary of Commerce Robert H. Hinckley suggests that administration of air safety has improved since CAA, CAB, Weather Bureau, Coast and Geodetic Survey, and Bureau of Standards have been brought under the general supervision of his office. He explains the unusual number of recent major accidents by the remark "the law of averages is simply catching up with us." Secretary of Commerce Jesse H. Jones, whose pacifying influence on the Hill will be strong, says simply, "as long as we have flying there will be accidents."

Defense Set-Up

When President Roosevelt left last month for a rest he carried with him the secret of the ultimate integration of the defense organization.

Shortly before he left, his right hand man William H. McReynolds, issued a statement announcing that the President had taken from the National Defense Advisory Commission its funds and had given them to the Office of Emergency Management, and that the Office of Emergency Management would use the funds for administrative and operating expenses of its own and such agencies as are *established in it or coordinated through it*. It then appeared that by Executive Order the following agencies have been coordinated through, or have been established in, the Office of Emergency Management: Office of Production Management (the Knudsen-Hillman unit); Division of Labor of the Advisory Commission; Division of Agriculture of the Advisory Commission; Division of Price Stabilization; Division of Transportation; Division of Consumer Protection; Division of Defense Housing; Division of State and Local Cooperation; Office for Coordination of Commercial and Cultural Relations Between American Republics; National Defense Research Committee; Defense Communications Board; Division of Information; Division of Central Administrative Services.

The Division of Central Administrative Services maintains the central budgeting machinery, the accounting, the fiscal control system for the Office of Emergency Management and its constituent agencies; and shall have complete control over provision of personnel and general office services for the several agencies of the OEM. Obviously, the OEM is the overlord of *all* defense agencies. As presently constituted Sidney Sherwood is the Director of the Division of Central Administrative Services, which holds the purse strings and bosses the operation of the offices. And McReynolds, who signs himself "Liaison Officer for Emergency Management," says, "under the President's letter to me I have established the Division of Central Administrative Services which will be under my supervision." The implication is clear that McReynolds has at least temporary supervision over the whole OEM organism. The question is to define what the word supervision means in this instance.

We guess that McReynolds is acting as an interim administrator of the whole Defense organism. Mr. Roosevelt undoubtedly left the determination of the ultimate headship of this nerve center of Defense until he gets back. Meanwhile, McReynolds acts as a sort of conduit for Presidential ideas and orders. There is in some White House quarters the thought that this arrangement would be ideal to continue indefinitely. In effect the President would be the direct ultimate head of the ultimate Defense organization, and McReynolds would be buffer. But there seem to be other people in the old New Deal group who hold there should be a vigorous head of different caliber than McReynolds. They are grooming Leon Henderson for the job; and if they manage finally to persuade FDR, Henderson will become the OEM head. The chances are that the drifting, shifting, changing condition that we have grown to regard as normal, will be the condition that will continue.

Meanwhile, Bill Knudsen sits smiling, genial and talkative. There is a pervasive force in this man that makes him probably the most steady and elemental single thing in the Capital. They say he has not drawn a penny from the Government since he left his $300,000 General Motors job, not even a cent for expenses when he travels. They cannot induce him to file an expense account. And it is logical that the great and overwhelming number of business men, industrialists, financiers, capitalists, administrators, and others, who have gradually built themselves into the prevailing force of this Defense Government, should turn to Knudsen as their leader.

Aluminum for Light Aircraft

Knudsen does not agree with Stettinius about the rationing of aluminum to some divisions of the airplane industry. He thinks the pinching may be harmful as well as unreasonable. The idea has filtered well through the OPM that the Civil Pilots Training Program is desirable. It was made clear that strict aluminum rationing would arrest the program dead in its tracks by late April. Men came to Washington from many of the 675 airplane schools that use from 2 to 20 planes each, who felt apprehensive about the future if they could not secure replacements. They made OPM people see that 7000 students would almost immediately be grounded. OPM people were impressed by the need for at least 5710 light planes required to carry on the CPTP this year. They learned that really 8600 light planes should be built, for which 1,638,000 lbs. of aluminum are required. The whole aluminum production question was opened up by the light plane discussion.

There are some people in the OPM who now wonder why there should be an aluminum shortage. We have the greatest practical reserve of bauxite in the world. There is an almost illimitable supply of the mineral in the British and Dutch Guianas, and there are stupendous fields in Arkansas, Tennessee, Alabama, Mississippi, and in other States. Bauxite can easily be transformed into alumina, and the extraction of aluminum from alumina is mainly a question of electrolytic power. And the discussion over the necessities of light planes brought out the fact that former President Hoover's plan to produce vast quantities of electric power by steam plants at the heads of the coal mines, especially in the East, would be entirely practical. The supply of power by steam plants would obviously be a swifter job of equipment installation than the construction of huge hydro-electric plants. Electricity is urgently needed for many defense industries. There is an acute shortage which is growing. Quite possibly out of the demand for aluminum for the light planes may immediately come a larger steam plant electric power development.

New Legislation

Sen. Sheppard, chairman, Senate Committee on Military Affairs, sponsored S. 1063 which increases the pay of officers and men in the parachute unit by $100 per month. It will be enacted. Sen. Walsh, chairman, Senate Committee on Naval Affairs, introduced SJ-HR 2953, which passed the Senate, increasing indefinitely the number of naval aviators in the line of the regular Navy and Marine Corps. Rep. Jennings Randolph sponsored an additional bill, HR 3386, providing for the establishment of a glider pilot training program under CAA.

APRIL 14-16

1941 Machine Tool Electrification Forum. Auspices Westinghouse Elec. & Mfg. Co., E. Pittsburgh, Pa.

APRIL 18

N.I.A.A. Midwest Regional Conference. Sponsored by Chicago, Milwaukee, St. Louis, and Indianapolis Chapters. Hotel Sherman, Chicago.

APRIL 22-25

Twelfth Annual Safety Convention and Exposition and Aeronautical Dinner. Aviation sessions sponsored by Aeronautical Section, National Safety Council. Hotel Pennsylvania.

APRIL 24-26

Southwest Aviation Conference. Wichita, Kans. C. R. Mooney, sec., 214 E. Armour Blvd.

APRIL 27

Michigan's "Dawn Patrol" Season. Capital City Airport, Lansing. Breakfast 8:30 A.M.

MAY 18

Air Rally for the Royal Air Force. Wings Field, Ambler, Pa. Auspices of British War Relief Society, Inc., and Emergency Aid of Pennsylvania.

MAY 19-23

Western Metal Congress & Metal Exposition. Pan-Pacific Auditorium, Los Angeles, under sponsorship of ASM.

MAY 23-24

Second Annual Aviation Conference of New England. Boston.

MAY 30

Third Annual Cruise. Pittsburgh to White Sulphur Springs. Sponsored by Aero Club of Pittsburgh.

JUNE 1-4

20th Annual NAA Convention and 4th American Aviation Forum, Louisville, Ky.

JUNE 7-8

11th Annual National Air Carnival. Birmingham. Steadham Acker, Show Director. Municipal Airport.

JUNE 28-JULY 13

National Soaring Contests. Elmira, New York.

OCTOBER 2-4

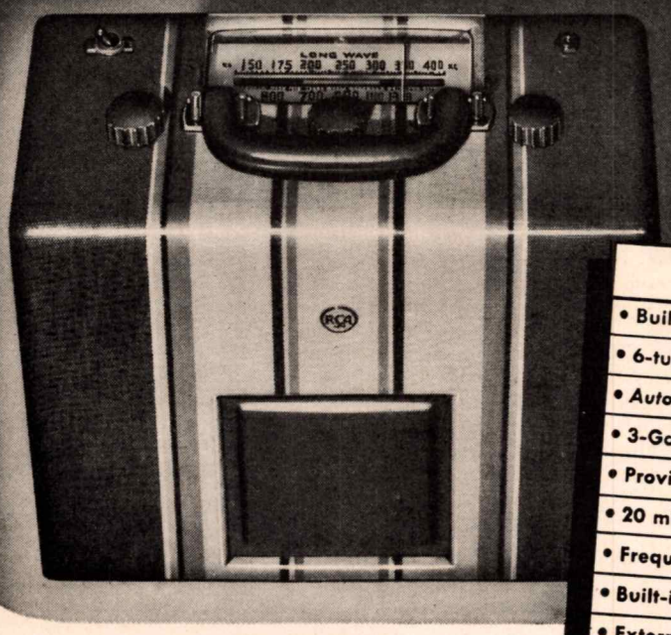
Annual Convention of the National Association of State Aviation Officials. Providence, R. I.

OCTOBER 30-31 & NOV. 1

SAE National Aircraft Production Meeting. Biltmore Hotel, Los Angeles.

NOW get RCA Performance IN A *Portable*

AIRCRAFT RADIO MODEL AVR-102 . . . . . $39.95 LESS BATTERIES



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• *Automatic* AC-DC Battery Changeover	✓	?
• 3-Gang Condenser for better selectivity	✓	?
• Provision for simultaneous Range Filter	✓	?
• 20 microvolts/meter sensitivity	✓	?
• Frequency Ranges: 150-400 & 550-1520 kc.	✓	?
• Built-in Directional Loop	✓	?
• External Antenna and ground connection	✓	?

Now, at a price no higher than you would pay for a dressed-up modified broadcast receiver, you can have the kind of radio performance that aircraft operation demands. Here is the extra sensitivity and selectivity of a *tuned* r.f. stage and 3-gang condenser... the higher efficiency-to-weight ratio of advanced RCA design and construction...for more efficient reception of weather stations, CAA and Airport Control Tower transmissions, or standard broadcast stations.

The self-contained batteries of the AVR-102 last nearly 200 hours without replacement. Batteries are disconnected automatically when the set is plugged into an ordinary 110-volt line, either AC or DC. Write for complete data.

RCA BROADCAST EQUIPMENT
From microphone to antenna

RCA *for Aviation Radio*

RCA MANUFACTURING COMPANY, INC., CAMDEN, N. J.
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AIR TRANSPORTATION

American Export Now May Get Appropriation

When the $1,229,000 appropriation earmarked for American Export Airlines' trans-Atlantic service was killed by a House Appropriations Subcommittee recently, indications were that the company would have to wait another year before it might operate its air mail service. However, after hearings in the Senate Appropriations Sub-Committee, an $800,000 appropriation was approved and submitted to the full Senate Committee, with all signs pointing to its acceptance.

Appropriation of the amount will permit American Export to operate a limited service. The Subcommittee also gave Pan American Airways an authorization to operate four instead of three round-trip trans-Atlantic services.

Government OK Given On Four-Engined Transports

Restrictions imposed by the National Defense Advisory Commission commercial aircraft priorities division which threatened to forestall further development and production of commercial aircraft during the existing emergency, were lifted last month to the extent that Lockheed and Douglas will be authorized to proceed with the construction of 4-engined aircraft for the domestic airlines.

The Lockheed project is undoubtedly the *Excalibar* for which Pan American Airways placed large orders some time ago; the Douglas project is the DC-4, a great number of which were ordered last year when the operators realized they needed larger and faster aircraft to meet the growing demands of their traffic departments.

Break in the rigid position taken by the Defense Commission against permitting commercial aircraft production from interfering with the military programs in commercial and military building aircraft plants, came after the operators, many manufacturers and members of Congress seriously objected to what they considered a weakening of our national defense structure. Senator Pat McCarran put into the record on Feb. 13, a statement which took up the case of the airlines.

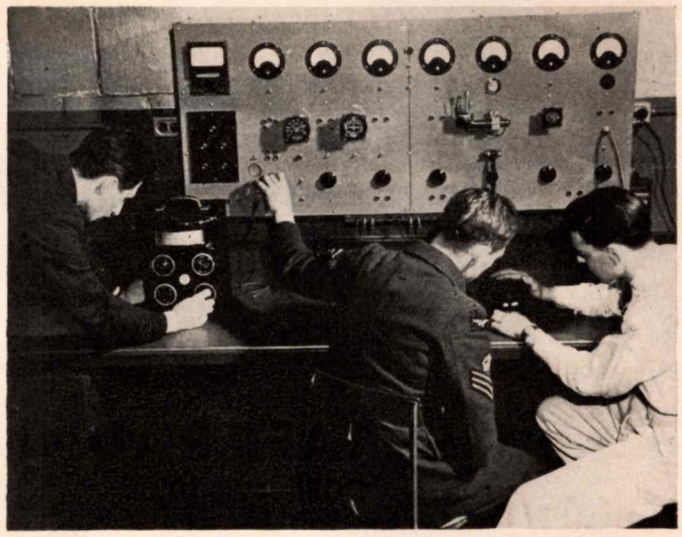
Four Major Operators Form Express Company

A long-awaited development in the industry took place last month when four major airline operators formed Air Cargo, Inc., to survey the possibilities of engaging in the business of transporting freight and express by air. American Airlines, Eastern Air Lines, Transcontinental & Western Air, and United Air Lines, were the organizing companies in the new venture.

While plans for the corporation have been discussed for some time with all of the airlines, and it is contemplated that the 16 domestic operators will participate in its ownership and control, the four organizing operators will undertake preliminary studies. It is expected they will make an initial expenditure of $100,000 to survey the possibilities of such a service as they have under contemplation.

Shortly before the announcement of the formation of the new company, the Civil Aeronautics Board dismissed the Railway Express Agency petition for a certificate of convenience and necessity. The board held that this company, which operates the existing air express business over the domestic lines, does not require such a certificate because it does not operate the aircraft, but handles ground service under contracts with the carriers.

According to L. O. Head, president of Railway Express, the CAB's decision will not affect its air express operations, and he said his company is making a survey of potentialities for air freight transportation. This study, he indicated, is covering the prospective market for this business.



Corner of Trans-Canada Air Lines maintenance shop at Winnipeg which overhauls, repairs and tests instruments for planes of the Royal Canadian Air Force

CAB Petitioned for Additional Routes

At least four, and possibly more, petitions were filed last month with the Civil Aeronautics Board for certificates of convenience and necessity covering new routes. Three of the petitioning companies already hold operating certificates, but a newcomer in the field also filed a petition which ranks as one of the most extensive on file.

All American Aviation's certificate covers six new routes to be serviced by the pick-up and delivery system. Should this petition be granted, it will permit service to 175 cities and towns in New York, Massachusetts, Connecticut, Rhode Island, New Jersey and Pennsylvania. The petition provides for twice a day service to each of the stops as follows: New York-Boston via New London, Conn., covering 33 intermediate points; New York to Boston via Greenfield, Mass., covering 31 intermediate points; New York to Syracuse via the Hudson Valley, covering 28 intermediate points; New York to Syracuse via Binghamton, N. Y., and Elmira covering 22 other intermediate points; New York to Harrisburg, Pa., via Williamsport covering 29 other intermediate points; and New York to Harrisburg via Philadelphia and 26 other intermediate stops.

Braniff is seeking permission to operate a line from Dallas to New Orleans via Shreveport, Alexandria, Baton Rouge, proposing 2 round trip flights daily and using 21-passenger DC-3 transports, and 14-passenger DC-2's. The petition requests passenger, mail and express service.

Chicago & Southern also petitioned the CAB during the month, seeking permission to operate between New Orleans and Shreveport via Baton Rouge and Alexandria, and between New Orleans and Dallas. C & S proposes to operate DC-3 equipment over both of the routes if it is successful in its application.

Mercury Development Corp., Indianapolis organization headed by Harold L. Plummer as president and Amberse M. Banks as vice-president in charge of operations, petitioned the Board for permission to operate mail and express services to 135 middle western towns and cities in seven states. Mercury's petition reveals it will use the pick-up and delivery system and operate Howard DGA-15s.

The petition asks for routes between Indianapolis and Grand Rapids via South Bend; Indianapolis and Detroit; Indianapolis and Springfield and Detroit; Indianapolis and Nashville; Indianapolis and St. Louis; Indianapolis and Chicago.

(Continued on following page)

Arrangement in one of TWA's Stinson for instrument flight instruction

"Beaverbrook Showed Me a Cryptic Cable"

MR. MARTIN DOING VERY NICELY HERE....DID SOME BOXING YESTERDAY AND WON BY A K.O. ...

Official British Press Service Photograph of Destruction at Taranto

***"The Glenn Martin Bomber . . . has won its wings with distinction . . . Beaverbrook showed me a cryptic cable he had received from a squadron-leader friend of his. The cable merely read, 'Mr. Martin doing very nicely here. Did some boxing yesterday and won by a K. O.'"*—QUENTIN REYNOLDS, in Collier's for January 25, 1941.**

Cablegrams are expensive; adjectives are luxuries. But in unadorned dispatches from the Mediterranean the Martin 167-B4, which the R. A. F. has dubbed the "Maryland," earns simple tribute from Britain's fighting men.

We read that the "Maryland" is "well suited to desert warfare." And Britain's enemies fall back in confusion from bomb-shattered strongholds in Northern Africa.

"A Glenn Martin bomber is credited with taking the Taranto pictures." And a round-up broadcaster from Cairo tells of an airplane which rode over the angry, awakened Italian naval base in the wake of British bombers and roared away with pictures of the ruin below, while pursuit craft and anti-aircraft snapped at its tail.

That cablegram above—it is an example of terse reporting; a thumbnail story of a bomber that can turn and fight like a pursuit ship.

And of vital importance is the fact that several hundred of these bombers have been sent into the war zones. To produce them Martin broke a world record of construction, built a 440,000-square-foot plant addition in 77 days, flew the first ship in six months and turned out the first order of more than a hundred in ten months. "Mr. Martin" is indeed "doing very nicely."

THE GLENN L. MARTIN COMPANY, BALTIMORE, MD., U. S. A.

Martin
AIRCRAFT

Builders of Dependable Aircraft Since 1909

TRADE MARK

...into the sky at 88 feet per second— on SHELL AVIATION GASOLINE

CURTISS-WRIGHT INTERCEPTOR-FIGHTER 21-B

Flying Weight—4,500 lbs.
Length—26' 4"
Span—35'
Climb—5,280' per minute
1,000 H.P. Wright Cyclone Engine
Fuel—Shell Aviation Gasoline

CURTISS-WRIGHT (ST. LOUIS) Uses Shell Aviation Gasoline Exclusively

OFF the runway and into the air shoots Curtiss-Wright's new 21-B . . . like a rocket into the sky. Up, up, up it goes . . . prop biting the air at 2,200 R.P.M. . . . now just a speck in the blue. Leveling off, her Wright Cyclone Engine, feeding on Shell Aviation Gasoline, knifes her through the clouds at 333 M.P.H.

What a plane! What a performance! What a beating plane, engine and oil must take at today's super speeds! That's why Curtiss-Wright uses gasoline on which it can depend . . . Shell Fuel in the tanks of all new 21-B ships.

Shell Gasolines mean quick starting, instant throttle response, long cruising range in *any* ship. In fact, it is 100 octane gasoline (produced commercially for the first time by Shell) that makes American military planes unexcelled in performance, speed and flying range.

• • •

No wonder airport operators the country over are taking to fast-selling Shell Aviation Products! It pays to back a winner. Investigate. Address: Shell Oil Company, Inc., 50 West 50th Street, New York, N.Y., or 100 Bush Street, San Francisco, Cal.

SHELL

AVIATION PRODUCTS

(Continued from preceding page)

January Traffic Jumps Almost 30% Over 1940

Reports for the month of January, reflecting traffic over the domestic airlines, reveal that the industry again is heading for a banner year. Although 1940 was the best year in the history of the airlines in this country, January 1941 started off almost 30% better than the same month last year in the number of revenue passengers carried.

Domestic airlines, 16 in number, carried 177,055 passengers during the month, flying 69,047,939 passenger miles and 8,889,649 miles; these can be contrasted with 136,282 passengers, 55,231,952 passenger miles and 7,271,154 miles for the same month a year ago.

American Airlines carried the greatest number of revenue passengers during the month—57,788. This company was followed by: Eastern Air Lines with 32,639; United 22,703; TWA 17,150; PCA 12,360; Braniff 8898; Northwest 6189; Delta 3906; Western Air 3344; National 2888; C & S 2807; Northeast 2001; Mid-Continent 1541; Continental 1094; Catalina 881; and Inland 866. Gross revenue during the month from the nationwide air express service of Railway Express Agency showed a 27.5% increase over January, 1940 when there were 93,751 shipments, an increase of 22% over the corresponding month in 1940.

Traffic continued to show more than steady gains in February, preliminary returns revealing many companies experiencing increased business over the previous month and over the same month in 1940. Chicago & Southern reported a gain of 90.5% in revenue passengers over February, 1940; PCA had a 91.8% increase; Northwest a 21.55% gain; Northeast a 74% jump; and the domestic lines as a whole increased 41.76% in revenue passenger miles.

Pittsburgh-Birmingham Service to Be Doubled

Service on the new Pittsburgh-Birmingham route will be more than doubled twenty-five days after inauguration, it was announced last month by President C. Bedell Monro of Pennsylvania - Central, who outlined completed plans for reducing the Pittsburgh-Birmingham travel time by more than an hour by placing new 1941 Douglas Capital Liners on the route on April 1.

Two additional round-trip flights will be inaugurated with the new planes between Birmingham and Pittsburgh and, in addition, a local round-trip will be flown daily between Pittsburgh and Knoxville. Two round-trips will be flown between Pittsburgh and Birmingham with the Capital Liners effective April 1. Leaving Pittsburgh, they will fly non-stop to Knoxville, continuing to Chattanooga and Birmingham. A morning and afternoon flight will be made daily in each direction. North-bound from Birmingham, the de luxe service will provide two-stop service to Pittsburgh, three-stop service to New York, Buffalo, Cleveland and Akron and schedules to Detroit. Service between Birmingham, Chattanooga and Knoxville would be substantially improved to Boston, Philadelphia and many other points with more frequent service being established.

Effective April 1, the Boeing airliners will make a round-trip daily between Pittsburgh and Knoxville, making stops at Clarksburg and Charleston, W. Va., Tri-City Airport, Tenn. This will provide a total of three round trips daily between Pittsburgh and Knoxville.

Alaskan Operator Reports Increase in Traffic

Yukon Southern Air Transport, operating out of Edmonton and Vancouver, B. C., to Whitehorse, Yukon, with branch lines to northern British Columbia points, reported the following traffic for the year 1940:

Passengers, 2022; passenger miles 848,882; express (pounds) 95,227; express miles (tons) 10,657; mail (pounds) 81,219; and mail miles (tons) 16,515.

American Cooperates In Testing New Fuel

American Airlines' engineers, with specialists from the Co-operative Fuel Research Committee, have been conducting high altitude flight tests on a new blend of fuel, a small quantity of which will boost the power of high-test gasoline to aviation gasoline requirements.

The new blend, when added to high test gas, is believed to be the solution to the problem of producing large quantities of high quality aviation gas.

With Captain M. G. Beard, chief engineering pilot of American Airlines at the controls, the group has been flying a series of three hour tests for the past few weeks.

Special instrument panels with indicators to record heat at various points on the engines as well as engine efficiency have been installed in the cabin of a Flagship which was taken from service for the tests. Photographs are taken of the special panel every 15 mins. during the flight which is made at zero temperature at an altitude between 10,000 and 14,000 ft.

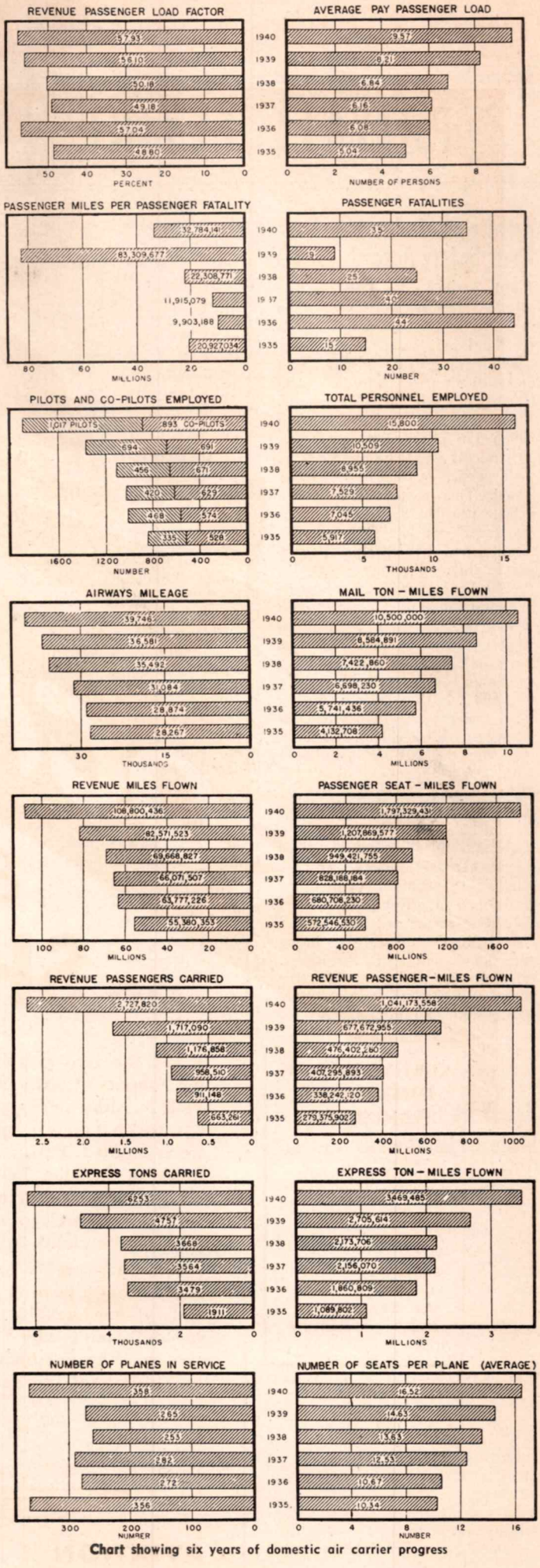


Chart showing six years of domestic air carrier progress

PRIVATE FLYING

Private Pilots Increase Their Safety Record

Private flying hung up another all-time record in 1940, when nearly a million miles were flown per fatal accident.

Pilots of private planes, with and without passengers, flew 229,000,000 miles in 16,500 airplanes. There were 231 fatal accidents in which 196 pilots, 138 passengers, 13 students and 9 ground crew or third parties—a total of 356—were killed. This means airplanes in private use flew 991,842 miles per fatal accident; 1,168,367 per pilot fatality, and 1,659,420 per passenger fatality.

1940 figures continue the year-by-year improving safety record in such flying over the last five years. Next to 1940, the year 1939 was the safest year for private flying, and so on back to 1936 when there were 93,320,375 miles flown, 159 fatal accidents, and only 586,920 miles per fatal accident.

During the last six months of 1940, 30,000 students received CPT flight training. They flew 96,000,000 miles during the year with a total of 31 fatalities including both students and instructors. This shows 3,160,000 miles flown per fatality, the highest figure ever established in private flying.

This safety record is reflected directly in the decrease in insurance premiums for CPTP students. Whereas in 1939, the rate for $3000 in the event of death, $1000 in the event of injury, and certain hospitalization and medical reimbursement benefits was $20, the 1940 rate was $9.

New York Group Opposes State Legislation

Officers for 1941 were elected, New York state bills regulating aviation were condemned, and the group offered its services to the governor for defense when the New York State Aviation Association met March 6 in the Roosevelt Hotel, New York City.

Officers named were Max Pollet of American Airlines, Inc., president; W. D. Guthrie, president of Roosevelt Field, vice president; Ollie Davis, distributor for Cessna Aircraft and Beechcraft at Roosevelt Field, sec.-treas.

Chief item of discussion was a bill introduced by Sen. Thomas C. Desmond of Newburg, setting up a state director of aviation and establishing a state aviation commission, and a companion bill setting aside a fund of $100,000 to carry on this work.

The association condemned the bill and opposed state regulation of aviation, including other proposed bills restricting flying on certain lakes.

The association pledged services of its 2800 members to Gov. Herbert L. Lehman in the state defense program.

New NATA Section Tends to Raise Training Standards

Initial steps to organize the Aviation Ground Schools Service Section of the National Aviation Training Association were taken Feb. 21-22 at a meeting in Kansas City. Twenty-two schools were registered and an organization committee of five was elected to convey this convention's recommendations to the N.A.T.A. Board of Governors.

The committee members are Don Frye, representing several schools under the name of Frye Aircraft Co., and Ralph E. Oliver, Midland Radio & Television Schools, both of Kansas City; J. W. Borton, General Airmotive Corp., Cleveland; John Wilson, Lewis School of Aeronautics, Lockport, Ill.; and Frederick H. Roever, Parks Air College, St. Louis.

One purpose of the Ground Service Schools meeting was to raise the ethics and standards of that division of aeronautical training. Fred M. Lanter, chief of CAA general inspection, speaking at the convention dinner, offered all possible aid to the group in efforts to repress the "fly-by-night" aviation training schools.

Urge Glider Training

Institution of a national program for civilian glider pilot training was urged last month by the board of directors of the Chicago Association of Commerce. With the need for a large reserve of pilots for national defense purposes, the government should officially undertake such a project, declared Leverett S. Lyon, chief executive officer of the Association, following its directors' meeting.

"Glider training proposals are becoming more numerous at Washington," Lyon said. "Several bills have already been introduced in Congress providing for training funds ranging between $500,000 and $5,000,000. Each of the bills, as proposed by Senator McCarran and Congressmen Costello, Cole, Fish, and Randolph, aims at the same ultimate purpose.

"All the bills are aimed at the same purpose. They differ only in method and the amount of money to be appropriated by Congress. All, however, direct that the program be supervised by the CAA."

Exhibit Opens

A preview showing of the permanent aviation exhibit sponsored by Safair, Inc., was held last month in their new quarters at 30 Rockefeller Plaza, RCA Building, Radio City, N. Y.

A showing of cloudscapes, painted and hung by Eric Sloane, of Roslyn, L. I., is one of the attractions. The Naval Reserve Aviation Unit, at Floyd Bennett Field, and the U. S. Army Air Corps are displaying aviation training methods. Civilian training is represented by a display from the motion picture, *I Wanted Wings*, and the new 1941 Piper Cub Coupe.

The official opening to the general public was on March 31, at which time a reception was held for Army and Navy officials, aviation writers, representatives of the Quiet Birdman and The Ninety Niners.

Freier photo

At the christening of the "Wings of Mercy" ambulance plane for Great Britain: (l-r) H. E. Mordan, Frank A. Tichenor, Mrs. Frank A. Tichenor, John Walker, and Geo. F. McLaughlin

Fairchild Amphibion for Mercy Work Goes to British

The first flying ambulance for Britain made possible by American donations, last month was christened *Wings of Mercy* by Mrs. Frank A. Tichenor. Attending the ceremonies, held at Roosevelt Field, N. Y., were members of the aviation industry's "Wings of Mercy" committee, who are conducting a campaign, in cooperation with the British-American Ambulance Corps for at least $500,000 for a fleet of ambulance planes for British forces. The first airplane donated is a Fairchild amphibion.

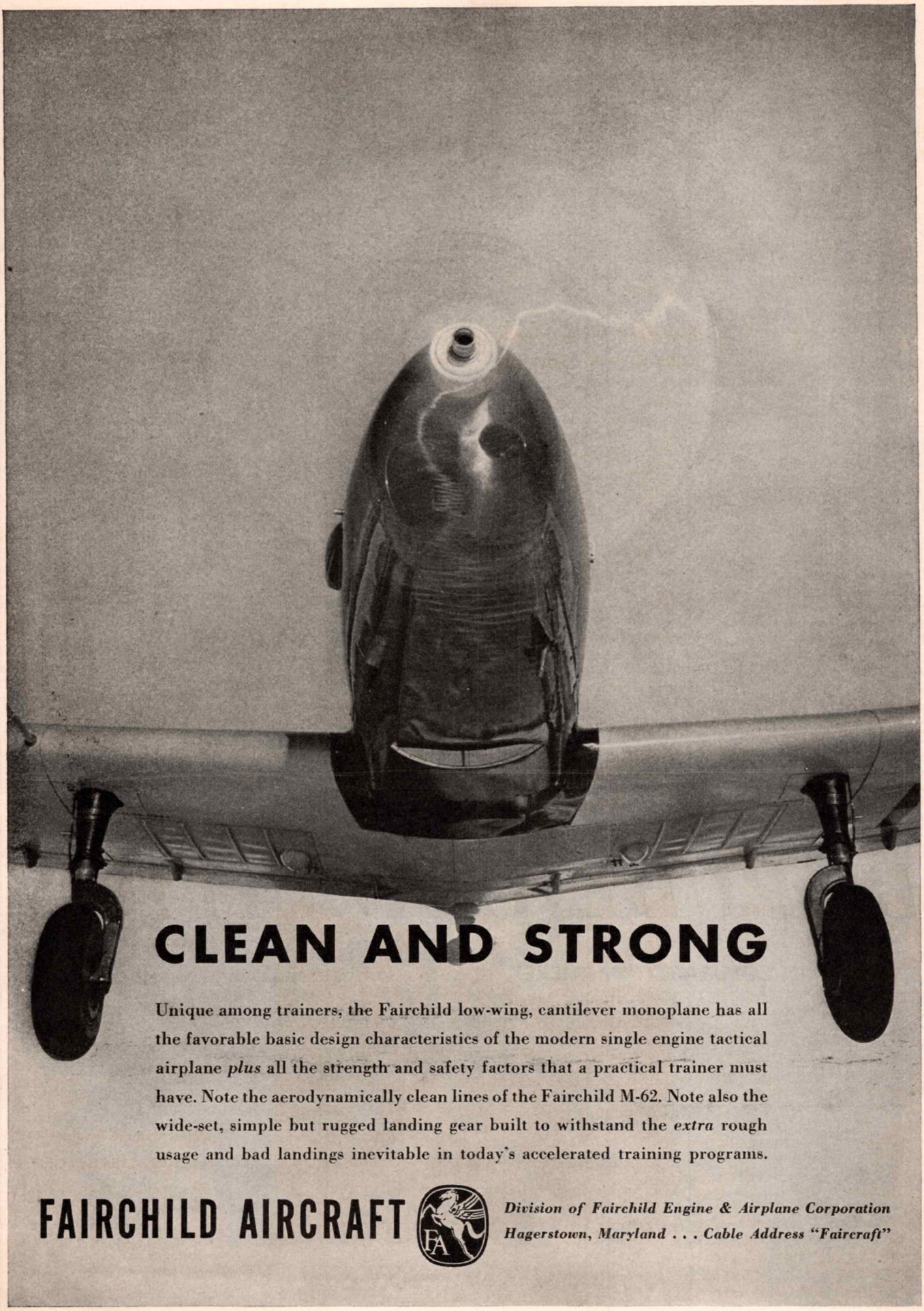
Members of the committee who took part in the ceremony were Frank A. Tichenor, publisher of AERO DIGEST, *Sportsman Pilot* and *Revista Aerea*, who is chairman; John B. Walker, president of the Airlines Terminal and vice-president of United Air Lines; George F. McLaughlin, editor of AERO DIGEST; and H. E. Mordan, director of the corps' Industrial Division.

According to Mr. Tichenor, the "Wings of Mercy" committee, composed of leaders in aviation, plans to raise the money by asking for contributions of at least "one sixtieth of one percent of the three billion dollar business the aviation industry will do in 1941 to put across this war-wise and humanitarian project and put it across fast." The program involves participation on the part of employees, executives and companies in the industry.

Other committee members are: Major Reed Chambers, Donald W. Douglas, Sherman M. Fairchild, Richard Goldsmith, Robert E. Gross, Casey Jones, Col. John H. Jouett, Grover Loening, Lauren D. Lyman, Thomas A. Morgan, Earl D. Osborn, J. Earl Schaefer, and Major Gill Rob Wilson.

LeRoy Airport Reverts To Original Ownership

The Donald Woodward Airport at LeRoy, N. Y., regarded as one of the best privately owned airports in the country, reverted to its original founder, D. W. Woodward, following a short industrial venture under White Aircraft, Inc.

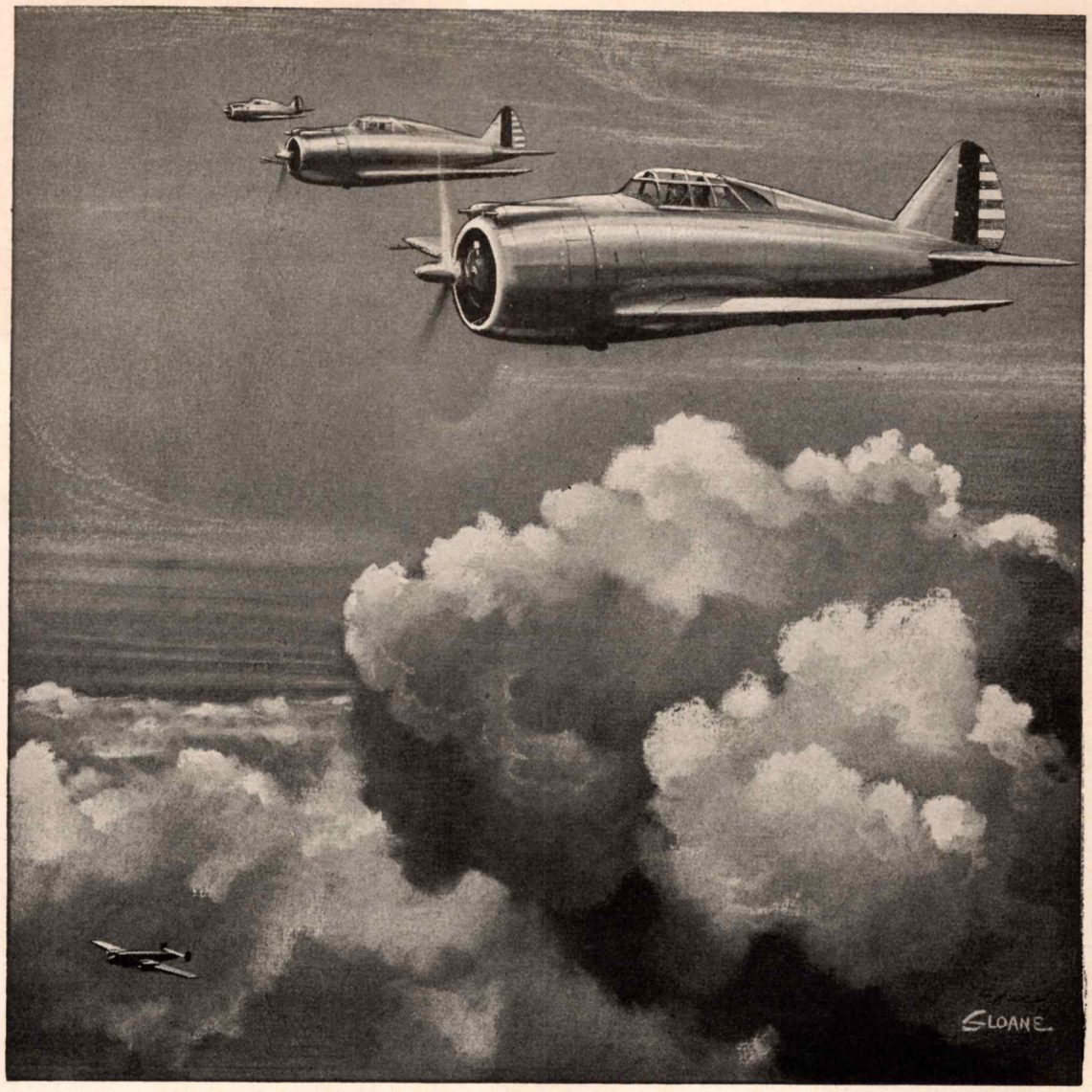


CLEAN AND STRONG

Unique among trainers, the Fairchild low-wing, cantilever monoplane has all the favorable basic design characteristics of the modern single engine tactical airplane *plus* all the strength and safety factors that a practical trainer must have. Note the aerodynamically clean lines of the Fairchild M-62. Note also the wide-set, simple but rugged landing gear built to withstand the *extra* rough usage and bad landings inevitable in today's accelerated training programs.

FAIRCHILD AIRCRAFT

Division of Fairchild Engine & Airplane Corporation
Hagerstown, Maryland . . . Cable Address "Faircraft"



REPUBLIC AVIATION

IN COMMAND "UP THERE". . . In the thin, cold air at 30,000 feet and over, Republic Aviation interceptors meet every challenge. Designed, built and supercharged for maximum military utility to counter high-altitude bombardment, these Republic Aviation pursuit planes will equip many squadrons in the powerful and rapidly expanding fighting forces of the United States Army Air Corps.

REPUBLIC AVIATION

REPUBLIC AVIATION CORPORATION
FARMINGDALE, LONG ISLAND, NEW YORK, U.S.A.

SCHOOL ACTIVITIES

Rankin Opens School

With the first detachment of 50 cadets attending, the Rankin Aeronautical Academy, United States Army Air Corps primary training center, located 7 miles S.E. of Tulare, Calif., opened ground and flight classes last month. An additional 50 cadets are expected within the next few weeks, giving the Academy its initial enrollment of 100.

The school has 980 acres available at present and has 460 acres under option, giving an ultimate mile and a half square field with a total of 1440 acres. This is the largest field used for Air Corps primary instruction purposes.

Present investment by the academy, of which J. G. "Tex" Rankin is president and chief pilot, totals $350,000. *(See page 89)*

Constructed in record time, the Academy already has two barracks with a capacity of more than 100 cadets; recreation hall, administration building, emergency hospital, mess hall and kitchens, a huge hangar and maintenance shop, control tower and classrooms.

Eighteen Stearman PT-17 biplanes are in service, and 15 instructors have reported for duty.

Plans are under way to increase the capacity of the Academy as needed during the next few months.

Army personnel so far assigned includes Capt. Charles J. Daly, A.C., commanding; Lt. John Kilgore, A.C., assisting; Lt. Neywood H. Roberdeau, Inf., adjutant; Lt. John E. Gilmore, M.C., flight surgeon, and Lt. Theo Drake Bradley, Inf. Nine enlisted men also have been assigned to the detachment to date.

First civilian ground school instructor is Herbert W. Smith.

Among the civilian instructors, all with more than 1000 hours of flying to their credit, are:

Edward V. Adair, Ralph R. Boring, George Barnes, Carl W. Berg, Earle Bradford, Chester A. Chenoweth, John A. DeRuiter, John D. Fry, Jennings R. Lund, Robert E. Matlock, Willis W. Morrison, Lyle B. Oliver, and Arthur L. Walters.

Karl Hughes is in charge of civilian ground personnel.

New Ground School

The Roger Q. Williams School of Aeronautics, located at Williams-Toledo Airport, Toledo, Ohio, will inaugurate a ground school this month. Courses to be included in the curriculum include aircraft factory mechanics, general aircraft mechanics, airline traffic management, airport management, and a short-term aeronautical engineering course.

Col. Williams already is operating a flight school in Toledo.

Add Equipment

Spartan School of Aeronautics in the last few months has added 17 new training airplanes, making a total of 22 now in operation. Ships now on the line are: 4 Fairchild M-62 trainers, 4 Piper Cubs, 3 Spartan Executives, 2 Spartan Biplanes, 3 Meyers trainers, 2 Waco cabin planes, 2 Taylorcrafts, 1 Fairchild 24. There is also a Series E Link Trainer.

* * *

Just added to the fleet of aircraft operated by Lewis School of Aeronautics, Lockport, Ill., was a Jacobs-powered Howard DGA-8, two Waco UPF-7 advanced trainers, and a Frankfort sailplane. The school's fleet includes 11 Piper Cubs, 1 Aeronca Chief, a Travelaire and a Stinson Reliant.

New Courses

To help fill the demands for trained meteorologists in the airlines, weather bureaus, and schools and colleges, Spartan School of Aeronautics, Tulsa, has established a new 12-month course in weather forecasting. New and modern equipment has been added for the course.

The Meteorology Department includes a fluorescently lighted laboratory, complete with individual desks, cross-sectional and three dimensional models to provide the students with a visual picture of air mass movements, density channel, ditto machine for duplicating weather maps, and more than 300 instructive cloud pictures; a weather station with a teletype machine for receiving reports from various sections of the country, and an outside observation tower. John Spikes is the meteorologist in charge.

Learning how to overhaul and test the more sensitive aircraft instruments at the American School of Aircraft Instruments

Expansion

Now getting the finishing touches in preparation for its formal opening on April 14, the new $135,000 unit built for the New England Aircraft School is the latest in a long line of impressive school buildings built because of the national defense impetus.

Providing facilities for courses in aircraft and engine mechanics, as well as for Army Air Corps crew-chiefs, the new school building is a hangar-like structure located near the entrance of the Boston Municipal Airport. It is two stories high and more than 100 ft. long with a sliding overhead door almost 53 ft. wide. Adjoining this shop on the ground floor is a 92-ft. engine shop. Both shops are served by an overhead monorail conveyor system for hoisting out airplane engines and conveying them to the engine overhaul room and testing blocks. Observation balconies overlook two sides of the hangar.

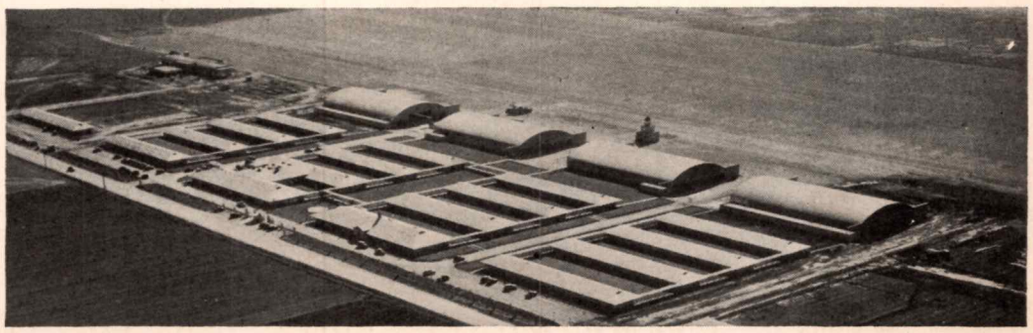
The whole building measures 165 ft. × 90 ft., and is of fireproofed reinforced concrete construction, automatically heated by gas and equipped with the most modern facilities for shadowless fluorescent lighting.

Adjoining the hangar are specialized shops for welding, metal working, wood working and a dope room.

* * *

To aid in meeting a need for draftsmen, Pratt & Whitney is collaborating with the University of Connecticut in offering an intensive 8 weeks' course of study designed specifically for this purpose. 25 students are enrolled for the first session, given at the Camp School in Hartford, a City public school, recently turned over to the University.

Instruction will be supplied jointly by the company and the University and will include courses in mechanical drawing, metallurgy, mathematics and shop theory. While in full-time attendance during the 40-hour-a-week period, the student will be paid 50c an hour. Upon graduation — and qualification as a junior draftsman—he will be employed by the Pratt & Whitney Aircraft engineering department.



25 buildings, 400 acres make up Cal-Aero Academy at Ontario, Cal., where Army cadets are trained

THE AIR SERVICES

4000 Army Aircraft

Secretary of War Stimson last month told the Senate Foreign Relations Committee the Air Corps now has 4000 planes, 3700 Regular Army Air Corps planes and 300 National Guard planes. Half of them are bombers and fighters, the balance trainers. He said that 1600 of the 3200 planes ordered in 1939 have been delivered, and that during the last two years the 2501 planes delivered comprised 958 combat planes and 1543 trainers.

The Secretary testified that delivery of combat planes has recently been held up because changes were necessary arising out of last summer's combat lessons from the European War. He said training planes have been delivered ahead of schedule. During January and February it is reported Pratt & Whitney, Wright, and Allison produced 2100 engines, including 1650 high powered engines for combat planes.

B-19 Ready for Outdoor Testing

Following the installation and checks of the landing gear on the Douglas B-19 last month, company and Air Corps officials looked forward to the 82-ton bomber's extensive testing program which is the next scheduled job before the airplane is flown for the first time.

Design and construction of the landing gear, by far the largest ever built, involved problems never before encountered, and required special machinery and production equipment.

Five different types of steel are employed in the retractable tricycle gear. So huge are the various parts that their machining necessitated the building of the world's largest turret lathe, with a working radius of 150".

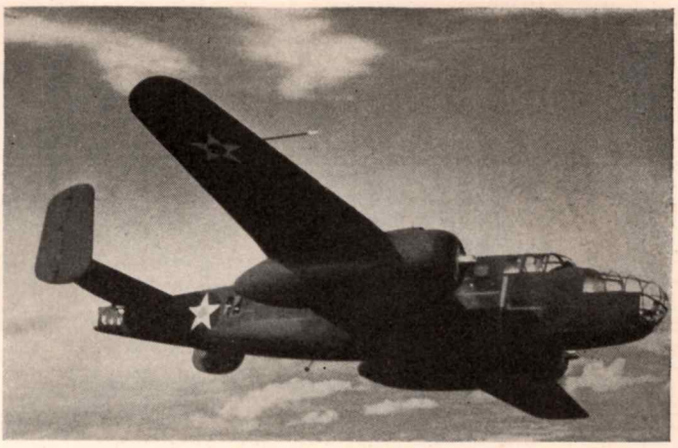
Solid steel bars weighing approximately 53,000 lbs. were forged and machined into two main legs and a nose strut with a total finished weight of 4000 lbs. The two main wheels, each 96" in dia., and the 54" nose wheel, weigh an additional 5800 lbs.

The landing gear and retracting mechanisms were built by Cleveland Pneumatic Tool Co., and the 24-ply tires and wheels by Firestone and Bendix.

Each main wheel is carried on an axle forged at right angles to its piston, the axle-piston unit weighing over 500 lbs. Brakes are provided on both the inboard and outboard sides of each of the 36"-thick wheel hubs.

Cylinder into which the piston telescopes is about the height of an average man, and is sealed to hold 2060 cu. in. of compressed air when the strut is fully extended. Under full load this is compressed to 864 lbs./in.^{2}.

With a span of 212 ft., and powered by four 2000 hp Wright *Duplex-Cyclone* engines, the B-19 can fly nonstop in excess of 7700 miles. Its load capacity includes 18 tons of bombs. Upon delivery to the Air Corps, it will become a flying laboratory for defense.



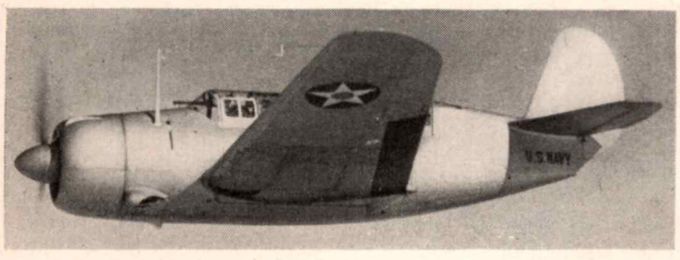
North American B-25 twin-engined bomber over Los Angeles

Navy Gets New Scout-Bomber

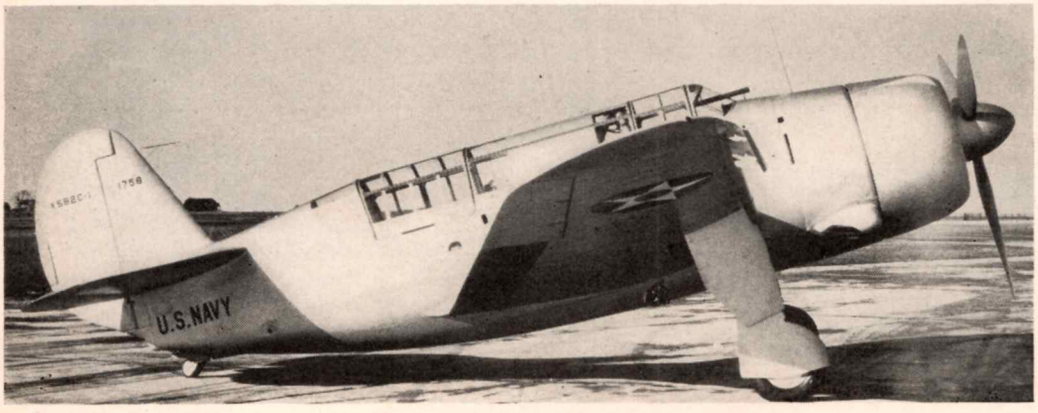
A scout-bomber which incorporates wide improvements over existing types anywhere in the world, has been developed for the U. S. by the Curtiss-Wright Corp. Designated the XSB2C-1, the airplane is a 2-place, all-metal semi-mid-wing monoplane powered by a 1700 hp Wright *Cyclone*, and equipped with a three-bladed Curtiss electric propeller.

Navy specifications for the new airplane called for a product which had twice the load capacity of any existing dive-bomber, twice the range and armament, a 4½-hour advantage in duration, and a speed which was 100 mph faster. These specifications are said to have been met in the XSB2C-1.

Featured are such improvements as unusually heavy armament, arrangement for carrying the bomb load in the fuselage, folding wings, hydraulic controls and wing slots. The airplane is bigger than the SBC-4, has improved performance characteristics and is exceptionally maneuverable.



Newest addition to the U. S. Navy, the Curtiss XSB2C-1 scout-bomber which incorporates many innovations new in dive-bombers



Civilian School Giving Cadets Basic Training

First contract in the history of the Army Air Corps to be awarded to a civilian school for basic training of Air Corps Flying Cadets has been given to Major C. C. Moseley's Cal-Aero Academy, and training of the first group of 100 cadets was begun at the school's Ontario, Calif. base on March 22.

The move is regarded as an experiment to prove that basic training can be handled by civil contractors as successfully as has primary training. It is expected to become a permanent policy, thus releasing Army fields and officers hitherto used for basic instruction to more important military pursuits and tactical operations.

Fifty BT-15 training planes have been assigned to Cal-Aero for this work, which constitutes the second ten-weeks stage of a Flying Cadet's 30 weeks of instruction. Basic training hitherto has been conducted by the Army at Randolph, Moffet, and Maxwell Fields.

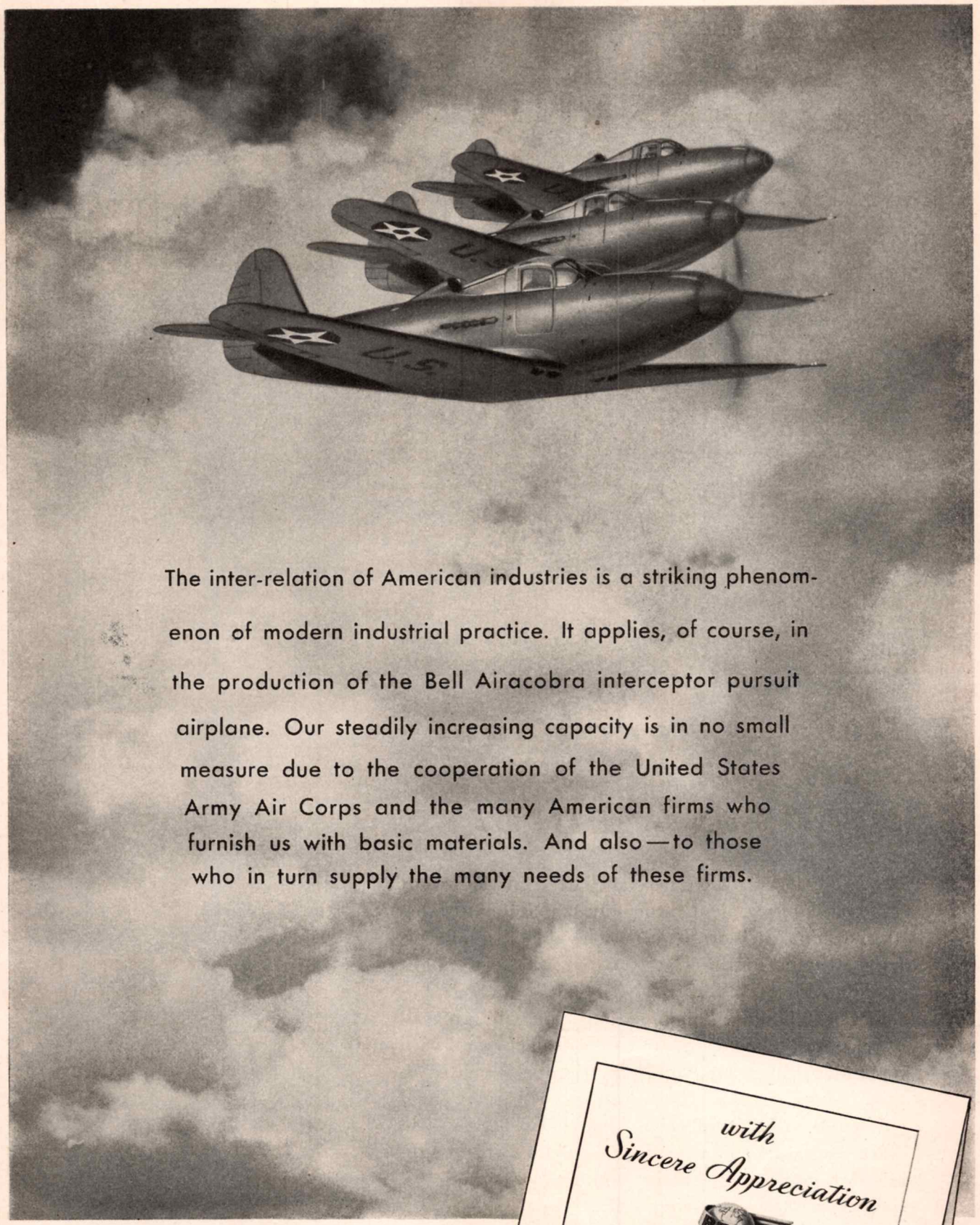
Curtiss-Wright Speeds P-40 Deliveries to Army

Speeding up delivery of completed aircraft to the Air Corps, Curtiss-Wright's Buffalo division last month inaugurated a plan whereby P-40 pursuits can takeoff from a specially-constructed "back door" runway at the east end of the plant and be turned over a few minutes later to Army attachés at Buffalo Airport.

The fly-away plan replaces the former system of trucking planes to the airport for final assembly, which consumed several hours.

The system also gives Curtiss-Wright more space at the airport and it can deliver the completed ships almost immediately after they leave the plant.

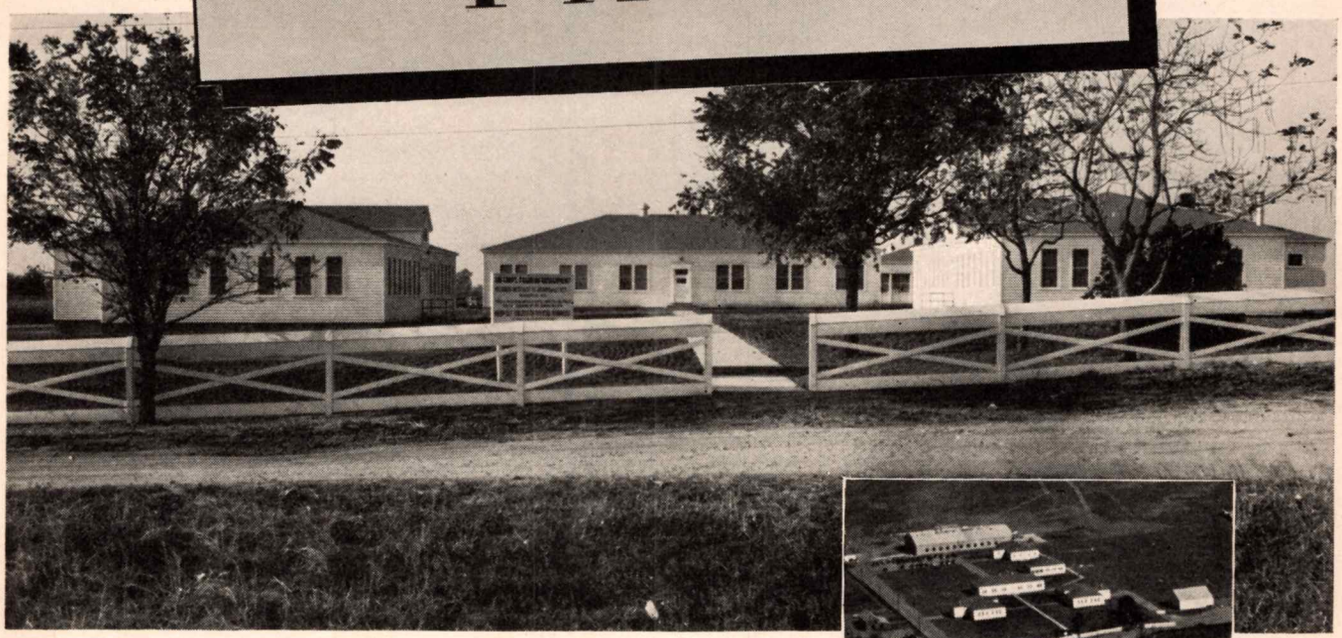
The runway at the plant is approximately 3000 ft. long and 150 ft. wide.

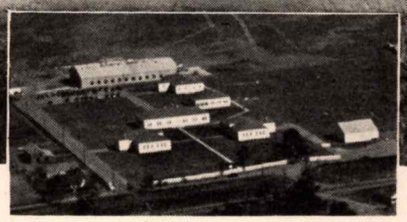


The inter-relation of American industries is a striking phenomenon of modern industrial practice. It applies, of course, in the production of the Bell Airacobra interceptor pursuit airplane. Our steadily increasing capacity is in no small measure due to the cooperation of the United States Army Air Corps and the many American firms who furnish us with basic materials. And also—to those who in turn supply the many needs of these firms.

BELL AIRCRAFT CORPORATION • BUFFALO, NEW YORK

Commercial Pilots



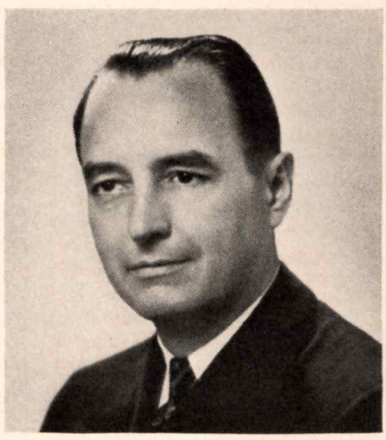


Missouri Institute of Aeronautics. Accommodates 220 flying cadets. Hangar space houses 75 training planes. The airport includes 353 acres. There are two subsidiary fields of 140 and 160 acres.

Here is your chance to CASH IN on your PILOTING ABILITY

IF you hold your Commercial Pilot rating and want to earn an excellent return on it, write or wire me at Sikeston, Missouri. You may be able to qualify as an instructor in the U. S. Army Air Corps flight training program.

If you fulfill initial qualifications, you will be placed on a salary and provided, free of tuition charges, with a standardizing course of flight training which takes about three weeks. Immediately on passing final checks given by an officer of the Air Corps, you will start your work, as a regular instructor, with a substantial increase in salary and with assurance of further increases for length of service.



Oliver L. Parks. In training centers, in addition to the Missouri Institute of Aeronautics, personally supervised by him, approximately 4000 U. S. Army Air Corps flying cadets will receive primary flight training in 1941.

Write or wire me for complete detailed information.

OLIVER L. PARKS

Missouri Institute of Aeronautics

SIKESTON, MISSOURI

ABOUT PEOPLE

D. W. (Tommy) TOMLINSON, vice-president in charge of engineering for Transcontinental & Western Air, Inc., has been named chairman of a special subcommittee of NACA to study de-icing problems in aircraft operation.

Tomlinson will head a 14-man group, composed of Army, Navy, CAA, U. S. Weather Bureau, educational and other aeronautical personnel who will undertake an exhaustive survey of the subject.

American Bosch Corp. last month announced the appointment of THOMAS J. KIELY as sales manager of its Aviation Division. Kiely has been associated with American Bosch since 1923, for most of this period in the Engineering Department. In his new capacity, he will be taking over a post that it has been necessary to create because of the company's increased activity in this field.

LAWRENCE D. BELL, president of Bell Aircraft, Corp., was recently elected to the board of directors of the Sterling Engine Co., of Buffalo.

The appointment of HOWARD E. EMIGH as superintendent of the new Reynolds aluminum alloy rolling mill at Lister, Ala., was announced recently by R. S. REYNOLDS, president of the Reynolds Metals Co. At the same time, COMMANDER HARRY J. HEUSTER was selected to serve in the newly-created post of special representative to assist in the coordination of defense production for the aviation industry.

New appointments of executives were announced by Laminated Shim Co., Inc., Glenbrook, Conn., following a recent meeting of its Board of Directors. E. B. NISBET, formerly purchasing agent and treasurer, becomes executive vice-president; E. R. YOUNG, former factory manager, becomes vice-president in charge of production; and RICHARD SEIPT, as the newly-appointed vice-president in charge of sales, takes on responsibilities in addition to those held during his term as sales manager.

Appointments of JOHN GROVES as manager of the new Washington National Airport, and of BENNETT H. GRIFFIN as Chief of the new Standardization Center of the CAA at Houston, Texas, were announced last month by COL. DONALD H. CONNOLLY, Administrator of Civil Aeronautics.

A. G. KINSMAN, general traffic manager of Northwest Airlines, appointed T. S. ZAWASKY to take over the newly created district traffic manager's post in Rochester, Minn. An employee of Northwest Airlines for two years, Zawasky will be in charge of a territory which covers such cities as Austin, Winona, Red Wing, Faribault, Albert Lea and Northfield.

VERNON GUNN, TWA district manager at Amarillo for the past four years, has replaced C. L. KAUDERER as district manager at Dayton, Ohio. Kauderer is resigning to accept the position of district sales manager for Pan American Airways' newly established Cleveland area office. The district managership at Amarillo has been taken over by J. D. HARRIGAN, who has been city sales manager for TWA in St. Louis, and J. J. MEADE, attached to the New York sales office has been elevated to Harrigan's former post.

MISS WILLIE PECK, Braniff Airways' chief hostess, has been promoted to Superintendent of Passenger Service, according to ROBERT J. SMITH, Braniff vice-president. Believed to be the first and only woman to hold such a position in the history of air transport, Miss Peck will supervise the many details involved in the passenger service the airline offers, and will continue to be responsible for the selection, training and supervision of Braniff's hostess corps. In addition she will now take full charge of food service and the commissary department.

WILLIAM W. BRITTON has just been made special representative for the Pacific Coast territory (including California, Oregon, and Washington) by the Jessop Steel Co., Washington, Pa. His headquarters are in the Chamber of Commerce Bldg., Los Angeles.

Election of LEWIS B. BARRINGER, to the position of director in the Briegleb Aircraft Co., Inc., was announced last month by WM. BRIEGLEB, president.

M. P. BICKLEY, district traffic manager of United Air Lines, announced the appointment of ROBERT O. BARBER as manager of United's tour department in New York. Barber has been connected with the foreign and domestic travel departments of the American Express Co. in New York for the last four years.

T. S. Zawasky

G. H. Tweney

E. V. Whallon

GEORGE H. TWENEY has joined the faculty of the University of Detroit as Instructor in Aeronautics in the College of Engineering.

W. J. AUSTIN, manager of national accounts for Transcontinental & Western Air, Inc., for the past three years, has resigned to accept the position of general sales manager for Missouri Aviation Corp., formerly the Bredouw Aeromotive Corp., which has headquarters in Kansas City.

SCHWARTZ, director of public relations. MAXWELL STILES continues in the Lockheed and Vega employ as assistant publicity manager.

The appointment of EDWARD V. WHALLON as District Traffic Manager of the United Air Lines in Philadelphia was announced last month by HAROLD CRARY, vice-president of Traffic of United. Whallon has been in United's New York office for 8 years.

J. D. Harrigan

W. J. Austin

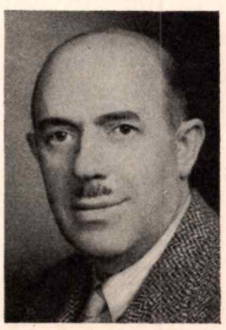
Bartley Whiteside

The Square D Co. announced the appointment last month of VICTOR CARBONARA as vice-president. Carbonara has for years been Chief Production Engineer and Works Manager for the Kollsman Aircraft Instrument Division.

BERT W. HOLLOWAY, former publicity executive with Universal and Paramount Studios, has joined Lockheed Aircraft Corp. and Vega Airplane Co. as publicity manager, according to LEONARD K.

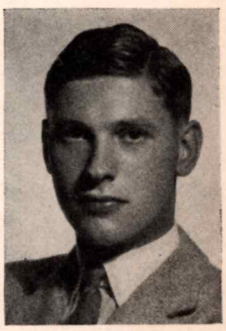
BARTLEY WHITESIDE, supervisor of training at Wright Aeronautical Corp., has accepted an appointment from the Office of Production Management to serve as Training-Within-Industry Consultant at its offices in Washington. Whiteside joined Wright as a mechanic in 1923 and held various positions associated with aircraft engine production prior to his appointment as supervisor of training in 1938.

LAUREN W. ATLER, chief tool



Nicholas N. Solovioff
(See page 94)

"Tex" Rankin
(See page 85)



"Boen" Hartsinck
(See page 71)

Gene Royer (See pg. 94)

H. E. Weihmiller

J. H. Habegger

designer for Engineering & Research Corp., has been named production manager for Colgate-Larsen Aircraft Co.

Organization of the Materiel Department to control the purchase and handling of materials used in the production of Republic planes, and the appointment of LT.-COL. HARRISON W. FLICKINGER, to head the Department, was announced last month by J. L. MCCLANE, vice-president and general manager of Republic Aviation Corp. Col. Flickinger has been Director of Republic's Export Department since 1939, and will continue to fill that post.

A former San Francisco newspaper man, Law has for two years been with Budd as publicity representative, and was formerly in charge of TWA's New York News Bureau.

JAMES H. HABEGGER, formerly associated with Oliver United Filters, Inc., has been elected to the board of directors of Aircraft Accessories Corp., and appointed treasurer of the company.

H. W. Flickinger

Allan Dysart

H. H. Kerr

RICHARD S. BOUTELLE, formerly Director of the Bureau of Safety Regulation of the CAA, has joined the Fairchild organization at Hagerstown in an executive capacity, to assist in the production of the low-wing Fairchild trainer.

Wickwire Spencer Steel Co., and its subsidiary, the American Wire Fabrics Corp., announced the appointment of DEAN ROLLANS as General Sales Manager, with offices in New York.

RICHARD R. STODDART, vice-president and general manager of Lear Avia of California, Inc., has resigned to start Stoddart Radio Co., at 6630 Santa Monica Blvd., Hollywood.

Appointment of MARION LAW, JR., as public relations director for the Edward G. Budd Manufacturing Co. was announced last month.

ALLAN DYSART has been appointed Chief of the Inspection Department of Republic Aviation Corp. Dysart has been with Republic since 1935.

The Weatherhead Co. last month announced the appointment of HENRY H. KERR as Western Manager with headquarters in Los Angeles. Kerr has for many years been engaged in the development, engineering, and sale of hydraulic devices for aircraft.

H. E. WEIHMILLER, formerly Eastern Representative and from 1937 a vice-president of Consolidated Aircraft Corp., who has been away from the company for approximately a year, has returned and has rejoined the corporation in his former capacity. He will handle the Washington office and eastern activities.

Election of W. E. BURDICK as a vice-president of Vultee Aircraft, Inc., was announced last month by the Board of Directors. Burdick has been Director of Army and Navy Contracts for Vultee since last November, and prior to that was a member of the Sales Department.

Also announced during the month was the election of HUGH M. FENWICK as vice-president in charge of sales.

L. E. OSBORNE, Manager of Manufacturing and Engineering for the Westinghouse Merchandising Division, has been granted a leave of absence to join the staff of the Defense Commission in Washington.

RICHARD M. HUBER has been appointed Project Engineer in charge of the airways engineering department of Transcontinental and Western Air, Inc. Huber joined TWA in Aug., 1936, as a radio technician and became successively construction engineer and airport engineer. He succeeds M. TUCKER, who resigned to accept a position with the airport commission of Los Angeles. Elevated to Huber's former position is WILLIAM M. SCHWARZ, who has been with TWA as an engineer since Nov., 1940.

DR. RALPH T. GOODWIN, formerly manager of fuel oil sales for Shell Oil Co., Inc., has been appointed manager of its aviation department. MILTON HAMON will be assistant manager.

ROBERT J. WOODS, chief design engineer of the Bell Aircraft Corp., has been awarded the Gold Key of the Buffalo Junior Chamber of Commerce, given annually for civic service.

BRIG.-GEN. CLARENCE L. TINKER, well known to National Guardsmen as former chief of Aviation Division of the National Guard Bureau in Washington, has been advanced from command of the air base at MacDill Field, Tampa, Fla., to command of the Third Bombardment Wing with headquarters at MacDill Field.

PHOEBE OMLIE has become senior private flying specialist for CAA. She is touring the country for the purpose of selecting airports where classes are launched to train people to become skilled as ground crewmen. The work is done by CAA in cooperation with WPA and the U. S. Office of Education.

MAJ. C. C. JADWIN, U. S. Air Corps, has been assigned to duty as air attaché at the U. S. Legation in Sofia, Bulgaria.

LT.-COL. JOSE PEREZ ALLENDE is the new air attaché of the Mexican Embassy in Washington.

GEORGE E. WARREN, formerly vice-president and chief of sales engineering of Fleetwings, Inc., has been elected vice-president of Bristol Aircraft Corp., Bristol, Va., and will take charge of engineering. Bristol is gearing up to produce Monomold plastic-bonded components for aircraft under the Vidal process. A. L. PATTERSON, President of Monocoupe Aeroplane & Engine Sales Corporation, assumes the position of vice-president of Bristol and is in charge of sales.

Among the latest additions to Aircraft Accessories Corp. staff is TIMOTHY E. COLVIN and JAMES A. LANE, who have joined the company as sales engineers.

Appointment of WALTER WOLLASTON, for many years general production superintendent of Brunswick-Balke-Collender, Muskegon, Mich., as works manager of the Vega Airplane Co., was announced last month by H. F. RYKER, vice-president.

CAPT. R. P. HARRIS has been named Assistant Operations Manager for Mid-Continent Airlines. Harris, who formerly was Assistant Superintendent of Flying at Minneapolis, Minn., will be based at the airline's headquarters in Kansas City.

FRANCIS DOWNEY, JR., former manager of the Niagara Falls Airport and more recently station manager there for Canadian Colonial Airways, has joined Bell Aircraft Corp.

SAE Meeting

(Continued from page 66)

met by increasing the number of propeller blades, width of propeller blades, or even double propellers rotating in opposite directions. Charles M. Kearns, of the same organization, discussed propellers with more than three blades.

Henry C. Hill, Wright Aeronautical Corp., told the gathering we are gearing to increase our production from 2000 to 3000 engines per month. He asserted these American engines are the reason the British have been able to make 1000-mile raids in all kinds of weather. He said in developing the modern aircraft engine, American engineers have inaugurated an entirely new manufacturing technique which is as far removed from automobile manufacture as the automobile was from the carriage. This, in his opinion, is the principal reason for the inadequacy of the Reuther plan for 500 airplanes a day, and the Ford plan for 1000 planes a day. C. C. Carlton, managing director, Automotive Section for Air Defense, reported that already five companies are systematizing their facilities to produce engines, parts, and assemblies, for thousands of bombers.

Official Photograph U. S. Army Air Corps

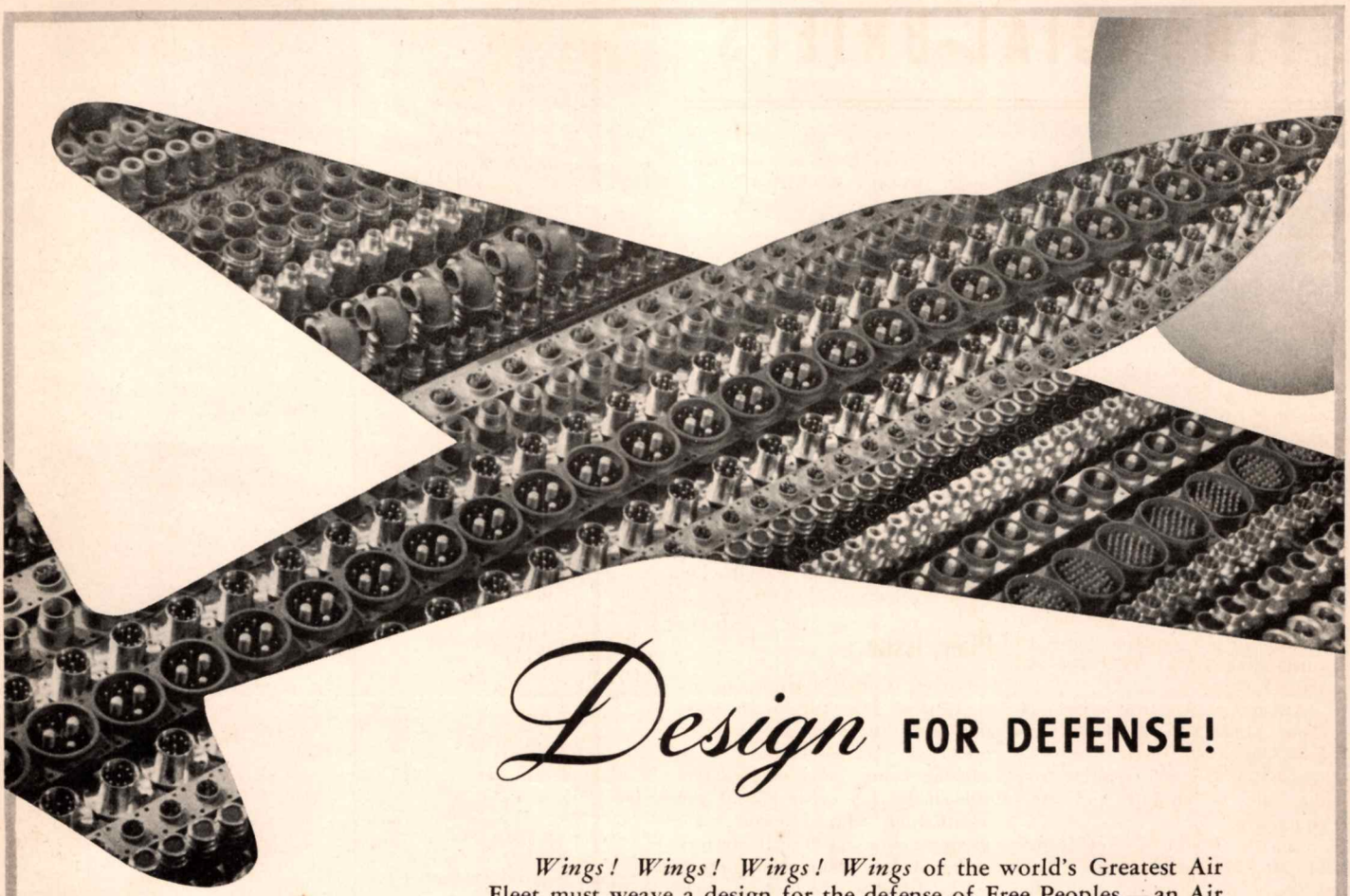
DELIVERIES of twin-engine BEECHCRAFTS are now being made at an ever-rising rate for use in connection with the National Defense Program. The U. S. Army Air Corps has released the photograph and data concerning its AT-7 Navigation Trainer shown above:

> "The airplane is an all metal, low wing monoplane with retractable landing gear and twin rudders. It is powered with two Pratt and Whitney 9-cylinder 450 horsepower engines, and carries a crew of five. This is the first training airplane procured solely for training student navigators. It is equipped with a chart table, aperiodic compass and stabilized drift sight for each of three students, and a celestial navigation dome for sextant readings."

New production facilities are almost completed and will be in full use within a few weeks. They will greatly expedite the BEECHCRAFT contribution to the National Defense Program.

BEECH AIRCRAFT CORPORATION ★ 6403 EAST CENTRAL AVENUE ★ WICHITA, KANSAS, U. S. A.

BEECHCRAFT



Design FOR DEFENSE!

Wings! Wings! Wings! Wings of the world's Greatest Air Fleet must weave a design for the defense of Free Peoples — an Air Fleet that American Industry will not fail to deliver.

In this gigantic task CANNON Plugs *(Multiple-Contact Electrical Cable Connectors)* play a vital role. In serving practically every major plane factory, "Cannon" manufactures 8327 different fittings, to connect and disconnect the miles of cable wires over which pulse millions of electrical "heart beats."

Nine years ago "Cannon" pioneered the first Plug Assembly to eliminate the continual soldering and unsoldering of countless cable wires. New uses led swiftly to almost endless variations until today CANNON Plugs are listed under 8327 catalog numbers.

Thankful for the generous co-operation of the engineering fraternity and for the loyalty of its own skilled organization, the Cannon Company takes pride in its ability to serve the majority of America's great aircraft builders.

CANNON Cable Connectors are pre-eminent in the fields of Sound, Aeronautics, Geophysical Research, Instrument-Control on Ships, Television and Laboratory Panels as well as Industrial Power.

SIGNAL SYSTEMS, TOO

Nearly 26 years ago "Cannon" began its corporate life, developing sturdily into an organization supplying electric signal systems to such institutions as the Los Angeles Stock Exchange and the L. A. County General Hospital (3300 beds). "Cannon" became and still is the West's largest builder of electrical signal equipment for hospitals and public buildings. Emphasis is on the hospital equipment . . . Doctors' Paging Systems, Nurses' Call Systems and Doctors' In-and-Out Registers. If you have a problem in electric signaling, we might help you solve it. We should be glad to try.

CANNON PLUGS

CANNON ELECTRIC DEVELOPMENT CO. 3209 HUMBOLDT ST., LOS ANGELES, CALIF.

Eastern Sales Office - 220 Fifth Avenue, New York City, N. Y. Chicago Agency-Kelburn Engineering Co., 600 W. Jackson Blvd.

FINANCIAL BRIEFS

Financial Reports

Stockholders last month received year-end financial reports from aircraft and airline companies which in practically every case indicated substantial increases in net profits over 1939. A summary of the reports follows:

SPERRY CORP.: — Net income $7,854,176 or $3.90 a share on outstanding capital shares; 1939 net was $5,462,060; taxes equaled $9,163,841 compared with $2,825,991 in 1939.

RYAN AERONAUTICAL:—Net income $358,343 or 82 cents a share on outstanding capital stock; 1939 net was $90,728; taxes equaled $218,834.

VEGA AIRPLANE:—Net income $71,654 or 16 cents a share on outstanding stock; 1939 net was $86,311.

AMERICAN AIRLINES:—Net income $1,858,549; 1939 net was $330,300; 1940 revenue was increased by $250,835 resulting from the sale of aircraft and other equipment.

CURTISS-WRIGHT:—Net income $15,746,874, equal to almost $1.81 a share on common stock, and after dividends of $2 a share on Class A stock; 1939 net was $5,218,259; provision for taxes equaled $28,381,004.

UNITED AIR LINES: Net income $775,462, equal to 51.7 cents a share on outstanding stock; 1939 net was $776,534; taxes were $838,390.

EASTERN AIR LINES:—Net income $1,575,456, equal to $2.80 a share; 1939 net was $993,824; provision for taxes equaled $535,000.

GLENN L. MARTIN:—Net income $5,424,489, equal to $4.94 a share on capital shares outstanding; 1939 net was $4,110,606; Federal income and defense taxes were $2,007,000 and excess profits taxes $886,000.

LOCKHEED AIRCRAFT:—Net income $3,165,675, equal to about $3.17 a share on 1,000,000 shares outstanding; provision for taxes $2,066,050.

REYNOLDS METALS CO.:—Net income $2,428,276, equal to $2.10 a common share; 1939 net income was $1,526,891.

VULTEE AIRCRAFT:—Net income $374,457 or 36 cents a share on outstanding stock.

IRVING AIR CHUTE:—Net income $411,136; 1939 net was $381,929.

CONSOLIDATED AIRCRAFT: — Net income $1,400,645, equal to $2.30 a share on common stock and after $3 dividend on preferred stock; 1939 net was $1,104,326.

Dividends

The following dividends were reported during March:

AIR ASSOCIATES: $1.75 regular quarterly on preferred stock ($7 cumulative and convertible), payable April 1, to stockholders of record March 18; and 12½ cents regularly quarterly on common stock, payable March 25 to stockholders of record March 18.

IRVING AIR CHUTE:—25 cents regular quarterly payable April 1 to stockholders of record March 17; previous quarter included an extra dividend of 25 cents.

Plans Issue

Garrett Corp., aviation supply concern of Los Angeles, is making preparations to float a new preferred stock issue, the new financing being undertaken to provide funds for expansion of the organization which is now completing a new 76,000 sq. ft. factory at Los Angeles Municipal Airport.

The issue will consist of 4000 shares of $25 par cumulative convertible stock carrying a dividend rate of 5% a year, and convertible into common stock at any time at the basis of 5 common for 1 preferred.

* * *

Rearwin Aircraft & Engines, Inc., has filed with the SEC a registration statement covering 220,000 shares of authorized common stock of $1 par value and common stock purchase warrants for 100,000 of these shares.

Of the total registered, 120,000 shares will be offered to the public, 115,000 representing new financing for the company. The remaining 100,000 shares of stock will be reserved for exercise of the common stock purchase warrants. Underwriters will be F. L. Rossmann & Co., and Colyer, Beckley & Co., Inc., of New York, and Chapman & Co., of San Francisco. Proceeds will be used for working capital and to improve the current position of the company, for the purchase of additional equipment, and for development work.

Gets Listing

Governors of the New York Curb Exchange last month approved the application of Cessna Aircraft Co. for the listing of 350,000 shares of its $1 par common stock. The committee also approved the substitution listing application of Air Investors, Inc., for the listing of 15,786 shares of $10 par convertible preference stocks for a like number of shares of the convertible perference no par stock.

Thompson Elects Officers

All directors of Thompson Products, Inc., were re-elected last month at the annual meeting of shareholders. At the organization meeting of the Board of Directors held following the annual meeting, officers were re-elected and, in addition, W. M. Albaugh, formerly treasurer, was elected vice-president in charge of replacement divisions; and J. D. Wright, formerly secretary, was elected secretary-treasurer.

Directors re-elected were: Albaugh, L. M. Clegg, A. T. Colwell, F. C. Crawford, S. W. Emerson, E. A. Hahn, J. A. Krider, S. L. Mather, R. V. Mitchell and Wright.

Stearman Delivers 1000th Trainer to Services

Stearman Division of Boeing Airplane Co., Wichita, last month delivered its 1000th primary trainer under Army and Navy defense contracts. It was believed to be the first manufacturer to deliver this number of planes under the National Defense program.

A ceremony at the Wichita plant on March 15, attended by Stearman employees and observers, marked the delivery of trainer No. 1000, which went to the Army, and No. 1001, which went to the Navy. Major Ray G. Harris, representing the Army Air Corps, and Lieut.-Commander W. B. Ault, representing the Navy, accepted the

UNLISTED AVIATION SECURITIES

Issue	Bid	Asked
Aircraft Accessories	1¾	2½
Aircraft Mechanics	¾	1¼
Adel Precision Products	2¾	3¾
Airplane Mfg. & Supply	1	1½
Air Communications	¾	1¼
Aeronautical Corp. of America	3½	4½
American Export Airlines	11	15
American Airlines Pfd.	106	109
Aero Industries Tech. Institute	4¾	5¾
Aircraft & Diesel Equipment	2¼	3¼
Airplane Marine Direction Finder	¾	1¼
Aviation Capital	17	20
Barnard Aviation Equipment	1¾	2¾
Braniff Airways	5½	6½
Chicago & Southern Airlines	4	5½
Consolidated Aircraft Pfd.	60	63
Cessna Aircraft	4	5
Continental Aviation & Engineering	5	6
Central Airport	1	1¾
Columbia Aircraft Products	1¼	1¾
Delta Airlines	8½	10
Harlow Aircraft	¾	1
Harvill Aircraft & Diecasting	2¼	3¼
Howard Aircraft	1½	2½
Interstate Aircraft & Engineering	8	9
Jacobs Aircraft Engine	4¾	5¾
Kinner Motors	1¾	2½
Kellett Autogiro	1¼	2
Liberty Aircraft Products	6	7
Luscombe Airplane	¾	1½
Menasco Mfg.	2¼	2¾
Midcontinent Airlines	3¾	4¾
National Airlines	7	8
Northeast Airlines	3¼	5¼
Northwest Airlines	10	11
Northrop Aircraft	5¼	6¼
Porterfield Aircraft	¼	¾
Piper Aircraft	6¼	7¼
Pollak Mfg.	7¾	8¾
Parks Air College	5¾	6¾
Rearwin Aircraft & Engine	1½	2½
Republic Aircraft Products	6	7
Solar Aircraft Pfd.	6½	7½
Standard Aircraft Products	6½	7½
Taylorcraft Aviation	2	3
Timm Aircraft	¾	1
Vega Airplane	6½	7¼
Warner Aircraft	1	1¾

New York prices at the close of business March 19, as furnished by the Aviation Dept., F. M. Mayer, New York City.

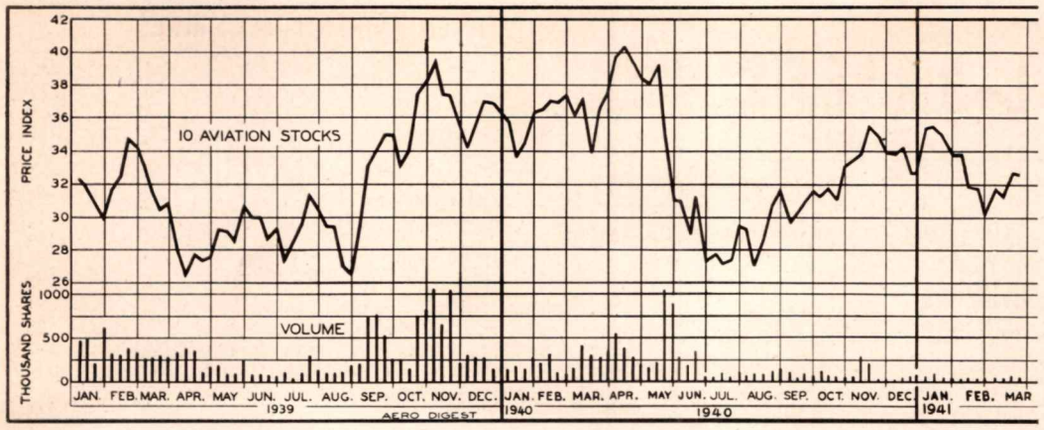


Chart showing average index of the ten leading aviation stocks in 1939, 1940 and the first quarter of 1941

trainers for the government as they were rolled from the assembly line and onto the field to join several dozen others that stood in line there ready for delivery.

Stearman was recently commended for its production, by Secretary of the Navy Frank Knox and Major Gen. Henry H. Arnold, Chief of the Air Corps, when it completed 180 Army and Navy trainers in 16 days. The Stearman plant worked three shifts a day and seven days a week during the period.

New Companies

Gene Royer, aircraft finance official of Fort Worth, Tex., announced the formation of Aircredit, Inc., a new finance company devoted exclusively to serving the southwest aviation industry. Headquarters of the firm are located in the Terminal Building, Meacham Field. *(See photo, page 90.)*

The Aircredit finance plans provide complete facilities for time-sales purchase of new and used aircraft, engines, parachutes, instruments and aircraft overhauls. An innovation has been presented to the southwest distributors and dealers in the Finance Kit and Predetermined Balanced Rate Chart, a feature designed to simplify the details of handling installment sales.

Officers and directors of the corporation include: President Gilbert Harrison, Jr.; Vice-President Sterling Holloway; Treasurer Marshall Cloyd; and Royer, executive-secretary and general manager.

* * *

Minneapolis-Honeywell Regulator Co. has organized an Aviation Division under the direction of W. J. McGoldrick, general manager; K. M. Abernathy, coordinator; and R. H. Whempner, field representative. The Division is directing its efforts toward developing, manufacturing, and selling aircraft instruments and accessories.

* * *

Formation of the Burklyn Corporation, 721 S. Victory Blvd., Burbank, Calif., was announced by Edward Burke and Ted Lynn, the organizers. The corporation will act as manufacturers' agents in the aircraft and industrial fields of the Pacific Coast, and already represent Saftee Glass Co., Buckey Portable Tool Co., Hansen Manufacturing Co., Shakespeare Products, and others.

The Electrol Aircraft Corp. was recently organized by Electrol, Inc., Clifton, N. J., pioneers in the oil burner industry. The new organization has taken over the Apollo Magneto Corp., Kingston, N. Y., and will make hydraulic equipment for bombers and pursuit planes.

Orders on hand total $750,000 with additional sizeable orders near consummation. Operating personnel of the 46,000 sq.-ft. Apollo plant has been doubled.

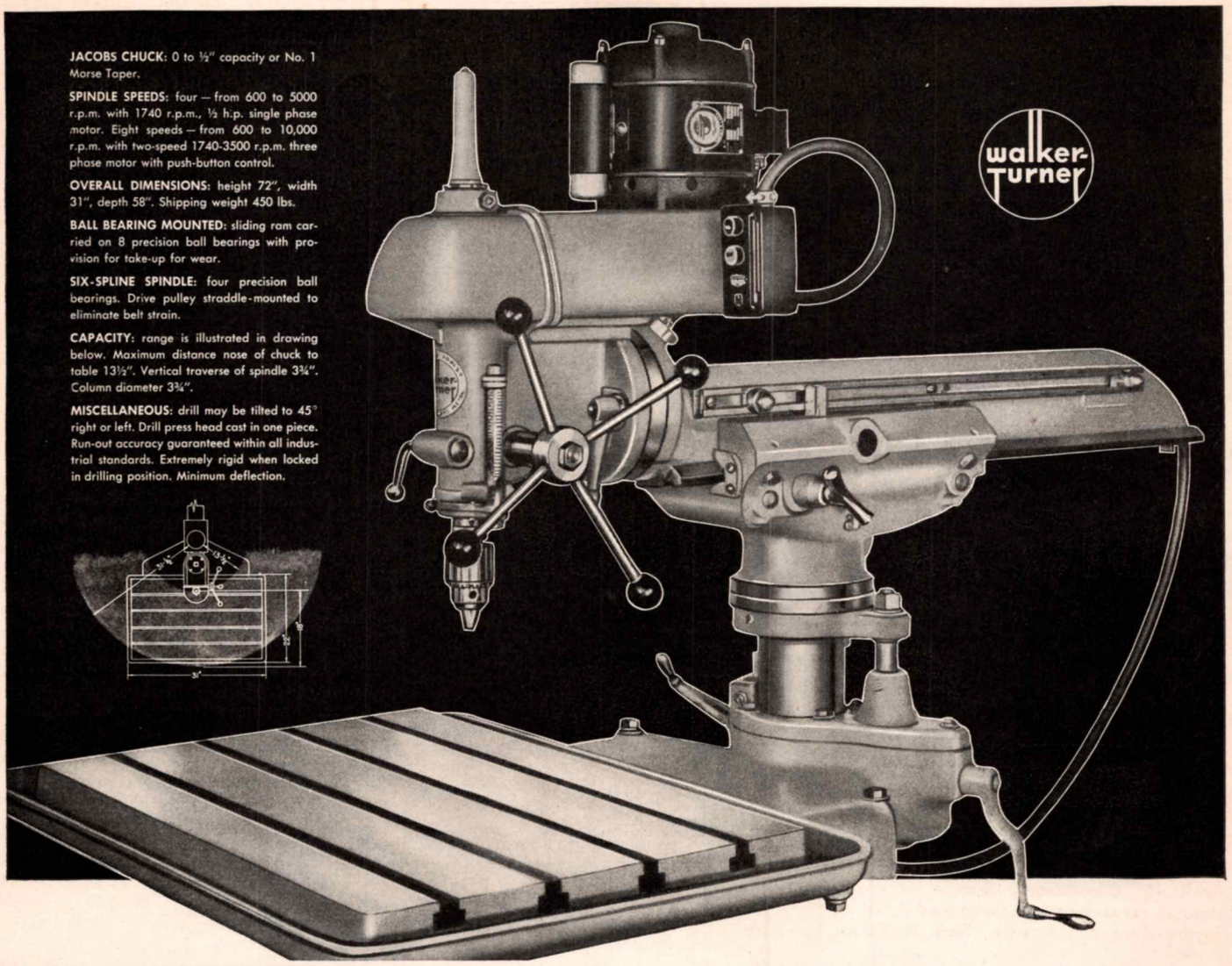
Stanley H. Brown, president of the parent company, has assumed the same post in the new company; Charles B. Lockwood is treasurer. Immediately responsible for the management of the Kingston plant is Nicholas N. Solovioff, who has been made acting vice-president of Electrol Aircraft. Frank Shaw, as Plant Manager, is assisting the latter. *(See photo, page 89.)*

* * *

Allied Aviation Corp. has been formed to operate as one of the licensees of Aircraft Research, New Rochelle, manufacturing parts and structures (both stressed and non-stressed) of moulded plywood. The company has bought the former B-J plant at Dundalk, Baltimore, from North American and is expected to be in production in a few weeks.

President is R. E. Breed, III. Other officers are: George Breed, vice-president; Burnham Litchfield, vice-president in charge of sales; and Walter F. Burke, chief engineer. Kurt Winters is secretary-treasurer.

	Week Ending March 1				March 8				March 15				March 22				Closing Mar. 26			
	High	Low	Change	Sales	High	Low	Change	Sales	High	Low	Change	Sales	High	Low	Change	Sales	High	Low	Last	Ch'ge
N. Y. STOCK EXCHANGE																				
American Airlines	46 1/2	43	+1 3/4	2,400	46 3/4	44	+1 3/4	2,300	48 3/4	47 1/2	+1 1/2	2,000	47 3/4	45 5/8	−2 3/8	1,100	46	45 7/8	46	+ 1/4
Aviation Corporation	3 3/4	3 1/2	− 1/8	14,100	3 5/8	3 1/2	− 1/8	19,200	3 7/8	3 1/2	+ 3/8	61,800	3 7/8	3 1/2	− 3/8	40,300	3 5/8	3 1/2	3 1/2	.....
Bendix Aviation	35 1/4	34 3/8	+ 1/8	7,100	36 3/8	34 1/8	+1 1/4	14,800	36 1/2	34 7/8	− 1/4	6,600	36	35	− 3/4	6,200	35 3/8	35 1/4	35 1/4	+ 1/4
Boeing Airplane	16 7/8	15 1/8	+ 3/4	9,600	16 3/8	15 1/8	.....	6,800	16 3/4	15 3/4	+ 3/4	10,100	16 3/4	15 3/8	−1 3/8	8,100	15 5/8	15 1/4	15 1/4	− 1/8
Consolidated	26 1/8	24 1/8	+1 1/2	3,000	25 5/8	24 3/8	−1	4,400	27 1/4	25	+2 1/4	10,500	28 5/8	26 1/2	+ 3/4	13,300	27 7/8	27 3/4	27 3/4	− 1/4
Continental Motors	3 1/8	3	.....	7,500	3 1/8	2 7/8	.....	6,500	3 5/8	3	+ 5/8	18,200	3 5/8	3 1/4	− 3/8	6,100	3 1/4	3 1/8	3 1/4	.....
Curtiss-Wright	8 3/4	7 7/8	+ 1/2	29,700	8 1/2	7 7/8	.....	14,600	9 1/4	8 1/4	+1	58,700	9 1/2	8 3/4	− 3/8	57,400	9	8 7/8	9	+ 1/8
Curtiss-Wright A	26 5/8	25 7/8	+ 3/8	2,300	27	26 1/8	+ 5/8	2,600	27 1/2	26 1/2	+ 5/8	3,400	27 1/8	26 1/2	− 5/8	2,200	26 3/4	26 1/2	26 1/2	.....
Douglas Aircraft	74 1/4	67 1/2	+5 1/4	8,800	73 3/4	71	+1 1/2	3,300	76	72 1/4	+ 1/2	4,700	75 1/4	72 3/4	− 1/2	2,700	73 1/4	72 7/8	72 7/8	− 1/4
Eastern Airlines	28	26 3/8	+ 3/4	2,700	27 3/4	25 1/4	−1	4,500	28 1/4	26 7/8	+1 1/4	3,400	28 3/8	27 1/4	− 1/4	1,900	26 3/4	26 3/4	26 3/4	− 1/2
Grumman	15	14	+ 1/4	2,000	14 1/4	14	.....	500	15 1/2	14 7/8	+1 1/4	1,100	15 5/8	15	− 1/2	1,000	15 1/2	15 3/8	15 1/2	+ 1/2
Lockheed	25 1/4	23 1/8	+1 3/8	9,400	24 3/4	23 3/8	− 5/8	6,600	25 1/4	23 3/4	+ 3/4	9,600	24 5/8	22 3/8	−2	6,000	22 7/8	22 5/8	22 3/4	+ 1/4
Martin, G. L.	26 5/8	24 7/8	+ 7/8	8,900	26 3/4	25 1/4	+ 7/8	4,300	28 7/8	26 1/2	+2 1/4	10,200	30	28	− 3/4	12,700	28 1/8	28 1/8	28 1/8	+ 1/8
National Aviation	8 7/8	8 3/8	+ 1/2	1,000	9	8 1/2	+ 1/8	800	9 3/8	9	+ 5/8	1,000	9 1/4	8 3/4	− 5/8	600	8 3/8	8 3/8	8 3/8	− 3/8
North American	14 1/2	13 5/8	− 1/4	7,400	14 1/2	13 1/2	+ 3/4	4,500	15 3/8	14 1/2	+ 1/2	9,100	15 3/8	14 1/4	− 3/4	6,700	14 1/4	14 1/8	14 1/8	− 1/8
Pan American	13 3/8	12 1/2	+ 1/4	3,100	13	12 1/8	+ 1/4	4,000	13 1/2	12 1/2	+ 1/4	4,500	13	12 1/8	− 3/4	4,700	12 1/4	12 1/8	12 1/8	− 1/8
Sperry Corp.	34	32 3/4	+1 1/8	4,300	33 7/8	32 1/2	− 3/4	5,500	33 7/8	32 1/2	− 1/4	5,300	33 3/4	33	+ 3/8	4,900	33 1/8	32 3/4	33 1/8	− 1/4
Square D Corp.	34	33 1/4	+ 1/8	700	34 1/2	33 3/4	+ 3/4	2,100	35	34 1/4	+ 5/8	2,300	34 7/8	34 3/8	.....	1,600	.....	.....	.....	.....
Square D Corp. pf.	.....	.....	.....	.....	113 1/2	113 1/2	− 1/2	10	.....	.....	.....	.....	113 1/2	113 1/2	.....	70	113 1/2	113 1/2	113 1/2	.....
TWA	14 1/4	13 1/2	.....	700	13 1/4	12 5/8	− 7/8	2,800	13 1/8	12 5/8	+ 1/4	1,800	13 1/8	12 1/2	− 3/8	1,700	.....	.....	.....	.....
United Air Lines	13 3/4	12 3/4	+ 1/4	5,800	13 1/2	12 5/8	+ 1/4	6,800	14 1/8	13	.....	5,600	13 5/8	12 5/8	− 3/4	5,900	12 7/8	12 7/8	12 7/8	+ 1/8
United Aircraft	39 7/8	37 1/4	+1 3/8	7,700	39 1/2	38 1/4	+ 1/8	6,100	40 3/8	38 3/8	+ 3/8	11,300	39 1/2	37 3/4	−1 1/8	7,200	38	37 5/8	37 5/8	− 1/4
Wright Aero	95	90	+5	110	93	93	−2	10	93	90 1/2	−2 1/2	30	93	91	+ 1/2	40	.....	.....	.....	.....
N. Y. CURB EXCHANGE																				
Aero Sup. Mfg. A	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Aero Sup. Mfg. B	5 7/8	5 5/8	− 1/8	1,000	6 1/8	5 3/4	+ 1/4	2,100	6	5 3/4	+ 1/8	1,700	6	5 5/8	− 1/8	1,000	.....	.....	.....	.....
Air Associates	.....	.....	.....	.....	10 3/4	10 3/4	− 1/4	100	12	11 1/2	+1 1/4	200	.....	.....	.....	.....	.....	.....	.....	.....
Air Investors	1 3/8	1 3/8	.....	100	1 1/2	1 1/2	+ 1/8	200	.....	.....	.....	.....	1 1/2	1 1/4	− 1/4	500	.....	.....	.....	.....
Beech Aircraft	6 5/8	6	.....	3,500	6 1/8	5 7/8	.....	600	6 1/2	6	+ 1/4	3,700	6 5/8	6	− 1/4	2,900	6 1/8	6	6	− 1/8
Bell Aircraft	21	19 3/4	+ 1/2	600	21 1/4	20	+ 5/8	900	21 1/4	20	+ 1/8	1,800	21	20	−1	700	.....	.....	.....	.....
Bellanca Aircraft	3 7/8	3 3/4	+ 1/8	500	5	3 3/4	+1	2,300	5	4 1/4	− 1/2	3,000	4 5/8	4 3/8	.....	900	4 3/8	4 3/8	4 3/8	.....
Breeze Corp.	6 1/4	6 1/8	− 1/8	900	6 1/4	6	+ 1/8	300	8 1/8	6 7/8	+1 1/2	8,700	8 1/8	7 1/2	+ 1/8	3,500	7 3/4	7 1/2	7 1/2	− 3/8
Brewster Aero	9 3/4	9	+ 3/8	1,600	9 1/4	9	− 3/8	600	10	9 1/8	+ 7/8	2,300	9 3/4	9 3/8	− 5/8	700	8 7/8	8 3/4	8 3/4	− 5/8
Can. Col. Airways	3 3/4	3 3/8	+ 3/8	1,100	4 1/4	3 3/4	+ 5/8	3,000	4 1/4	4 1/8	− 1/8	400	4 1/4	4	− 1/8	700	.....	.....	.....	.....
Fairchild Aviation	8 1/4	8	+ 1/4	400	8 1/2	8 1/4	.....	400	8 3/4	8 1/2	+ 1/2	300	8 3/4	8 1/2	.....	300	8 5/8	8 1/4	8 5/8	− 1/8
Fairchild Engine	3	2 3/4	− 1/8	2,700	3	2 7/8	+ 1/8	1,300	3 5/8	3	+ 1/2	5,700	3 1/2	3 1/4	− 1/4	1,900	3 1/2	3 1/2	3 1/2	+ 1/4
Irving Air Chute	11 1/8	11 1/8	+ 1/8	100	.....	.....	.....	.....	11 5/8	11 1/4	+ 3/8	300	11 3/4	11 1/2	+ 1/4	400	.....	.....	.....	.....
Penn-Central	11 1/4	11	+ 3/4	500	11	10 5/8	− 5/8	600	12	11 1/2	+1 3/8	2,500	11 3/4	11 5/8	− 3/8	500	11 3/4	11 3/4	11 3/4	+ 1/8
Republic Aviation	4	3 3/4	.....	1,500	4	3 1/2	+ 1/4	3,300	4 1/8	3 3/4	+ 1/8	4,000	4 1/8	3 5/8	− 1/2	5,300	3 7/8	3 7/8	3 7/8	+ 1/4
Roosevelt Field	.....	.....	.....	.....	.....	.....	.....	.....	2 1/8	2 1/8	+ 1/8	100	1 5/8	1 5/8	− 1/2	100	.....	.....	.....	.....
Ryan Aero	3 1/2	3 1/2	.....	100	3 3/4	3 3/8	+ 1/4	200	4	4	+ 1/4	300	3 3/4	3 3/4	− 1/4	100	3 3/4	3 3/4	3 3/4	.....
United Aircraft Products	9 1/2	8 5/8	+ 3/4	1,300	9 3/4	9 1/8	− 1/4	1,500	10	9 1/2	+ 1/4	600	10 1/8	9 3/8	+ 1/8	2,700	9 1/2	9 1/2	9 1/2	− 1/8
Vultee Aircraft	6 3/4	6 3/8	+ 3/8	1,200	6 5/8	6 1/2	− 1/4	400	6 3/4	6 3/4	.....	1,300	6 5/8	6 1/2	.....	500	.....	.....	.....	.....
Waco Aircraft	3 1/4	3 1/2	.....	200	3 1/8	3 1/8	− 1/8	200	3 3/8	3 1/4	+ 1/4	200	3 1/2	3 1/2	+ 1/8	100	.....	.....	.....	.....
Western Air Lines	4 1/4	3 7/8	+ 3/8	900	4 1/4	4	.....	600	.....	.....	.....	.....	4	4	− 1/4	500	3 7/8	3 1/2	3 1/2	− 1/2



JACOBS CHUCK: 0 to ½" capacity or No. 1 Morse Taper.

SPINDLE SPEEDS: four — from 600 to 5000 r.p.m. with 1740 r.p.m., ½ h.p. single phase motor. Eight speeds — from 600 to 10,000 r.p.m. with two-speed 1740-3500 r.p.m. three phase motor with push-button control.

OVERALL DIMENSIONS: height 72", width 31", depth 58". Shipping weight 450 lbs.

BALL BEARING MOUNTED: sliding ram carried on 8 precision ball bearings with provision for take-up for wear.

SIX-SPLINE SPINDLE: four precision ball bearings. Drive pulley straddle-mounted to eliminate belt strain.

CAPACITY: range is illustrated in drawing below. Maximum distance nose of chuck to table 13½". Vertical traverse of spindle 3¾". Column diameter 3¾".

MISCELLANEOUS: drill may be tilted to 45° right or left. Drill press head cast in one piece. Run-out accuracy guaranteed within all industrial standards. Extremely rigid when locked in drilling position. Minimum deflection.

THE NEW WALKER-TURNER RADIAL DRILL PAYS ITS WAY IN ANY SHOP

At last—a Radial Drill of the most practical design and construction, for **less than one-fourth** what you have been paying for this type of machine. This useful production unit meets all reasonable specifications for accuracy within the limits of its capacity. Designed for general industrial use, its adaptability makes it a **profitable investment for any shop.** The remarkably low price of **$325** (with motor) F.O.B. Plainfield, N. J., is made possible only by W-T volume production, which also permits us to offer reasonably **prompt delivery.**

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4741 Berckman Street, Plainfield, N. J.

Please send me complete information regarding the new Walker-Turner Radial Drill.

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WALKER-TURNER MACHINE TOOLS
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DRILL PRESSES • BAND SAWS • BENCH SAWS • TILTING ARBOR SAWS • LATHES
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WESTERN AIR LINES

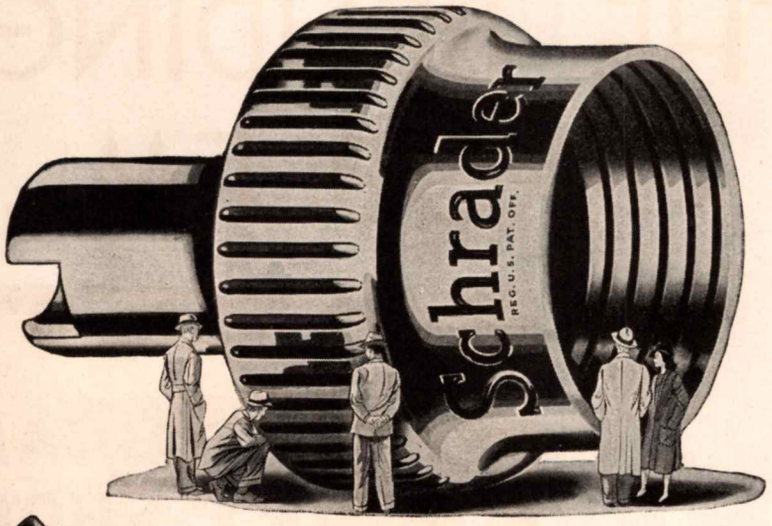
(Continued from page 54)

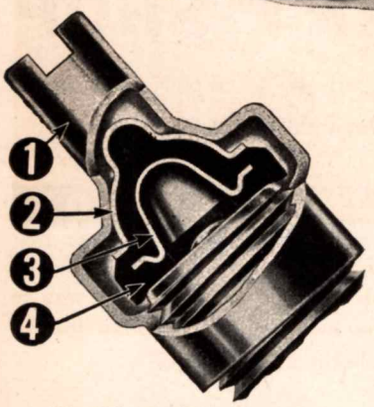
stretch northward came on Aug. 1, 1937, when Western Air acquired National Parks Airways, which operated from Salt Lake City to Great Falls; this is now known as Western Air's Division 2. In 1939, the company reached a new high in passenger traffic and reported a net profit of $74,556. At the end of 1940, Western Air passenger totals had surpassed the previous year by 55%, revenue passenger miles were up 42.5%, and net profit was $139,585.

The first nine months of the company's fifteenth year opened with the election of William A. Coulter as president. Coulter is a former Pennsylvania industrialist who had been a large stockholder since 1934. Leo H. Dwerlkotte was elected to the dual role of vice-president and secretary-treasurer, while Jimmie James remained vice-president in charge of operations, and Thomas Wolfe as vice-president in charge of traffic and sales.

The achievements chronicled above are important, but on its fifteenth anniversary Western Air is waging a hearty effort for further expansion. On file with the CAB are applications for an extension from San Diego to Phoenix *via* El Centro and Yuma; a Los Angeles-Palm Springs-El Centro service into the Imperial Valley; a second route to San Diego *via* San Bernardino, Redlands, and Riverside; a non-stop Los Angeles-San Francisco service and a route between these cities *via* the San Joaquin Valley cities of Bakersfield, Visalia, Fresno, Merced, Stockton and Sacramento; and a direct airway from Los Angeles to Denver *via* Las Vegas and Grand Junction, which will greatly reduce the route mileage and time over the Western Air-United Air Line's transcontinental airway from Los Angeles to New York.

IF A VALVE CAP WERE BIG AS A HOUSE..





Why Schrader Valve Caps Are Air-tight Up to 250 lbs. Pressure

1. *Valve Cap body or shell.*
2. *Brass Swivel Plate allows Cap Shell to turn independently of rubber washer as Cap is applied. This assures proper seating of washer and prevents distortion.*
3. *Brass Dome-Shaped Plate provides an* indestructible *chamber for safe clearance of valve core pin.*
4. *Molded Rubber Washer seals valve mouth when Cap is screwed on firmly by hand; while rubber between brass plates 2 and 3 provides spring action to* maintain *positive seal.*

you could make a tour of inspection through this giant cap and see the many unique construction features. But size could add nothing to its importance as a tire valve seal.

The dirt and muck that accumulate on a wheel are extremely abrasive and destructive to wearing or seating parts. A sealing cap is therefore essential to keep this dirt and grit *out* of the valve and to prevent possible loss of tire air *through* the valve.

NOTE TO TIRE SERVICE MEN

Seal every tire valve with an air-tight cap. This essential safety measure helps to maintain balanced tire pressures for safer take-offs and landings.

Schrader
REG U.S PAT OFF
TIRE VALVE CAPS

A. SCHRADER'S SON Division of Scovill Manufacturing Company, Inc. **BROOKLYN, N.Y**

RAF TRAINING

(Continued from page 46)

lending and leasing our Navy to ourselves to make the Atlantic Ocean safe for Democrats—and others.

Wireless operators and gunners go from the Manning Depots to one of four Wireless Schools for a 20-weeks' course in radio and signal lamps and air armament. Then they go to a Bombing and Gunnery School for a 4-weeks' course in the practical side. Final training is overseas.

The aerodromes will compare favorably, as to field conditions, paved runways, large, steel-framed, concrete-floored hangars, and other facilities, with those in our larger cities. The dormitories and mess halls are a hundred percent better in construction and comfort than anything we enjoyed in the last war—outside of Cranwell, in England, where the Royal Navy, as usual, did itself proud with furniture from captured German ships.

Incidentally, at Jarvis a tall slim handsome man, in the uniform of an RCAF Squadron Leader, with greying hair and the carriage of a Music Hall usher said, "Remember me?" I was ashamed to admit I didn't—but he probably wouldn't have remembered me either, only he'd received official notice of my visit. We had been instructors together at Cranwell, in the summer of 1918, he on *Camels*, I on FE's and Handley Pages in night-flying. He has worn better than I have—or the military life out in the open and long hours and hard work have reconditioned him. He's been a stove manufacturer all these years, and left his business to his employees while he chased back to the war. I am happy to say he has regained his lost youth.

The flying equipment is a splendid lot of English, Canadian, and American planes—in modesty we should mention ours last. The elementary trainers are mostly Canadian-built Fleets and de Havillands, followed by North Americans, Fairey Battles, Avro Ansons, Lockheed 10's and 12's—and that Fairchild 51.

The chief noticeable difference between this war and the last one was the attitude of the student pilots and air observers to their work. We took it

all with a laugh, as a gay adventure, the flying and the studying liberally mixed—to put it mildly—with hell-raising in the mess and while on leave. We fought for Freedom—and the distillers. These young fellows are in earnest—not that they don't play and enjoy sports. But they're not working at my kind of sports. "The lives of great men may remind them, they can make their lives sublime, and, departing, leave behind them foot-prints on the sands of time" —that sort of thing. As the life of an air gunner, in actual air combat from the tail of a large bomber, is said to be something under 60 minutes, there may be good reason for their serious outlook.

I thought perhaps my own advancing age had made me see these youngsters through more serious and possibly bleary eyes. But no. RCAF Squadron Leaders and Group Captains, to whom I mentioned my observations, unanimously confirmed them. You're right, they said —it's a different war—and the attitude of these kids is the most different thing about it. Man, they're training to be better soldiers than we were.

EDITORIALS

(Continued from page 42)

the preliminary course, with 3911 sent on to graduate from the secondary course; 1482 Primary Instructor Refresher Courses, 581 Advanced Instructor Refresher Courses, 131 Commercial Refresher Courses, and 31 Student Instructors. These figures were released Feb. 16.

The CAA announced March 9 that 4813 CPT graduates were in training or had been accepted for training at Air Corps or Naval Air Service centers. Actually in training were 1912 preliminary graduates at Army schools and 783 at Navy schools

Both the Army and Navy are anxious to get CPTP graduates. The Army finds that 39% of its cadets with no previous flight training are washed out, while only 16% of those with CPTP flight training are disqualified. This should answer those who have doubted the worth of this preliminary training at comparatively small expense. It enables the military to find desirable cadet material at a minimum expense of money, time, and effort. (See chart on Page 74.)

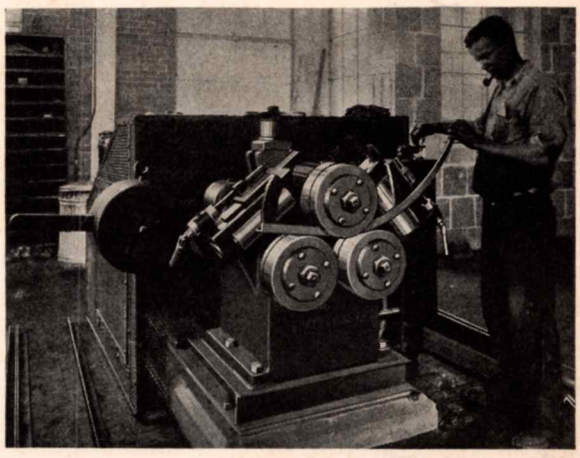
In addition to training these thousands of students, the CPTP has raised the quality of civil instructors. A large proportion of the instructors engaged to meet the Air Corps' expansion of civil contract schools have come from CPTP. 941 instructors have left CPTP for other work. 468 have gone to Army training centers; 27 to the Navy, 117 to Canadian military training centers operated by the Royal Canadian Air Force, 96 to active duty in the Army, 26 to active duty in the Navy, and 207 to help fill the need for more airline personnel.

With such evidence, who can doubt the worth of this civilian flight training plan? Well, the Director of the Budget—he evidently thinks so little of it that he refuses to give the CAA even half of last year's appropriation. Yet the Navy—which is a particularly hard-boiled outfit in its estimates of pilots—thinks enough of the value of the CPTP secondary course graduates to take them into the service for further training, with a credit of 33 hours Navy flying time because of their CPTP time.

The Spring CPTP is going on at about 907 training centers. In this program 15,000 are to be given the preliminary courses, and 4000 the secondary training, thus rounding out the original goal of 45,000 new pilots in the 1941 fiscal year.

What happens after that is in the lap of Congress. Assistant Secretary of Commerce Hinckely figures that by utilizing some money left over from the $37,000,000 appropriated last June we can still train 30,000 additional preliminary pilots in the next fiscal year if the budgeted $18,000,000 is not reduced. BUT in view of the emergency we should provide funds for double that number. Congress should give this serious study.

SOLVED!
THE BENDING PROBLEM...



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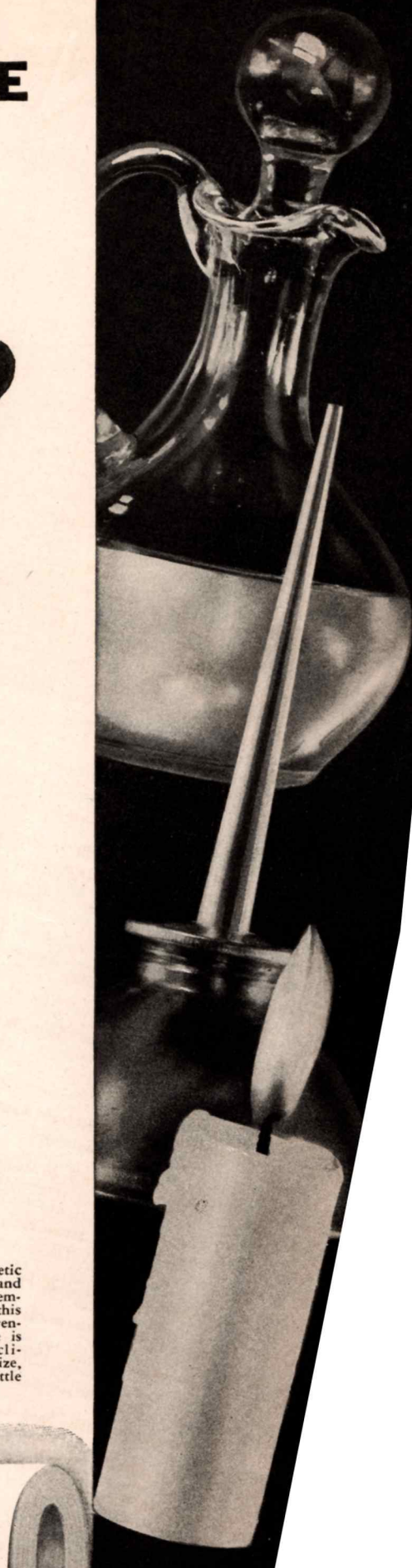

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THE STABILIZED TRACING PAPER

Aero Digest's AVIATION ENGINEERING

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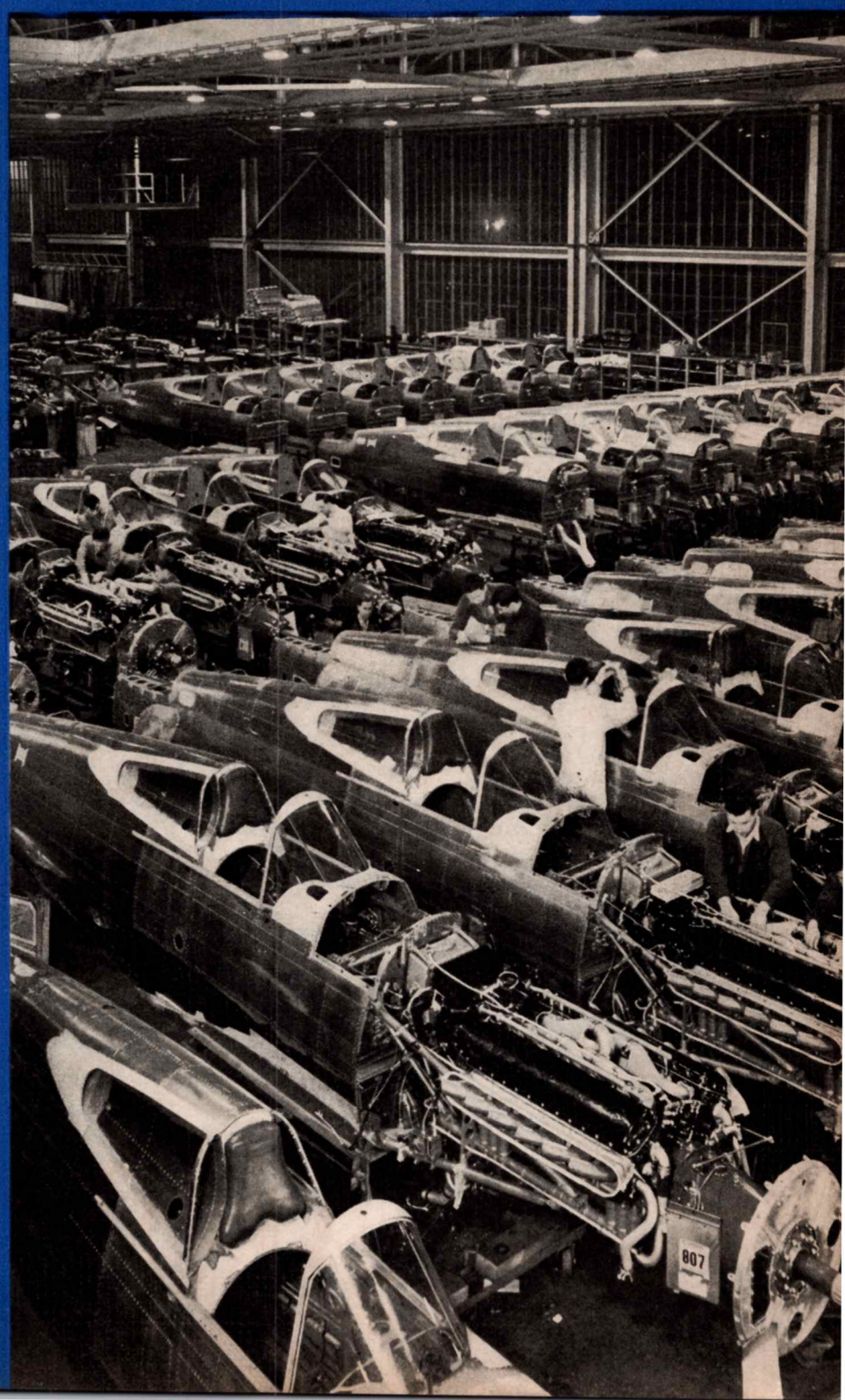


Guest Editorial

SOME of the LIMITATIONS on INCREASING AIRPLANE SPEED

FRANK W. CALDWELL

SUCH an amazing advance in the speed of military airplanes has occurred during the last few years that one wonders how far we are likely to go in this direction, and from what source future improvements may be expected.

From a superficial observation, the modern airplane may appear to be a highly streamlined vehicle, leading one to the obvious conclusion that there is not a great deal of room for improvement along these lines. However, we could think of the ideal airplane as one in which the flow of the streamlines would be so perfect that the only resistance remaining would be the skin friction along the surface exposed to the airstream (wetted area), with a small amount of resistance resulting from induced drag. During the last few years aerodynamicists have begun to compare the actual drag of airplanes with the skin friction drag of the ideal airplane having the same external dimensions. By this measure, present-day airplanes show up as being only about 50% efficient so there still remains the theoretical possibility of major improvements in streamlining. Indeed, improvement along these lines appears to be one of the most potent means of increasing airplane speed.

One of the proposals for improving speed which has received a disproportionate amount of publicity is that of reducing the frontal area of the fuselage by substituting a V-type engine for the radial form used in most air-cooled engines. This would only be valid if it became possible to effect the reduction in frontal area without a corresponding increase in installed weight of the power plant.

An examination of the effect of changes in frontal area and of power plant weight on the total wetted area of the airplane offers a reasonable view of the rough order of importance of these two factors. The table below indicates that a change of 10% in frontal area of the fuselage leads to a change of about 1½% in wetted area of the whole airplane, and a change of 10% in installed weight of the power plant leads to a change of about 2% in the wetted area of the whole airplane. (Installed power plant weight accounts for about 33% of the wing area in airplanes with 35 lbs./ft.² wing loading since added weight means additional wing area and drag).

Approximate Distribution of Wetted Area of Typical Airplanes with a Wing Loading of 35 lbs./ft.²

Gross weight (lbs.)	8,000	12,000	16,000
Wetted area, fuselage (ft.²)	310	400	490
Wetted area, wings & tail group (ft.²)	610	920	1,220
Change of total wetted area resulting from 10% change in installed power plant weight (%)	1.7	2.1	2.7
Change of total wetted area resulting from 10% change of frontal area of fuselage (%)	1.5	1.6	1.8

Even if the frontal area of the fuselage could be reduced by one-third without weight increase, the change in total wetted area would only be about 6% resulting in a change of only 2% in the speed of the ideal airplane. Such a reduction is scarcely practical because of the minimum space required for the pilot.

The propeller is becoming a critical element in increase of airplane speed. Up until the time airplanes attained speeds of 300 mph, each increase in speed led to an im-

provement in propeller efficiency because of the more favorable operating angles of the blades. At speeds above 300 mph, the blade angles become excessive so that propeller efficiency becomes progressively lower. Obviously, the angles are highest at the inner parts of the propeller so that this portion of the propeller is the worst offender from an efficiency viewpoint. If the inner third of the propeller is enclosed in a spinner, the most serious part of the loss can be avoided. At somewhere around 500 mph, however, even the outer parts of the blades approach excessive angles, and it may be necessary to use two oppositely rotating propellers on the same shaft to maintain reasonable efficiencies.

Utilization of the engine exhaust to furnish a jet for supplementary propulsion already has led to important increments in airplane speed. The thrust from the jet remains substantially constant with increasing airspeed so that the thrust horsepower obtained from it is nearly proportional to airplane speed. The effect of the jets also improves with altitude. While it is thermodynamically inefficient it is not wholly impossible that additional jets beside the engine exhaust may be used for short bursts of speed.

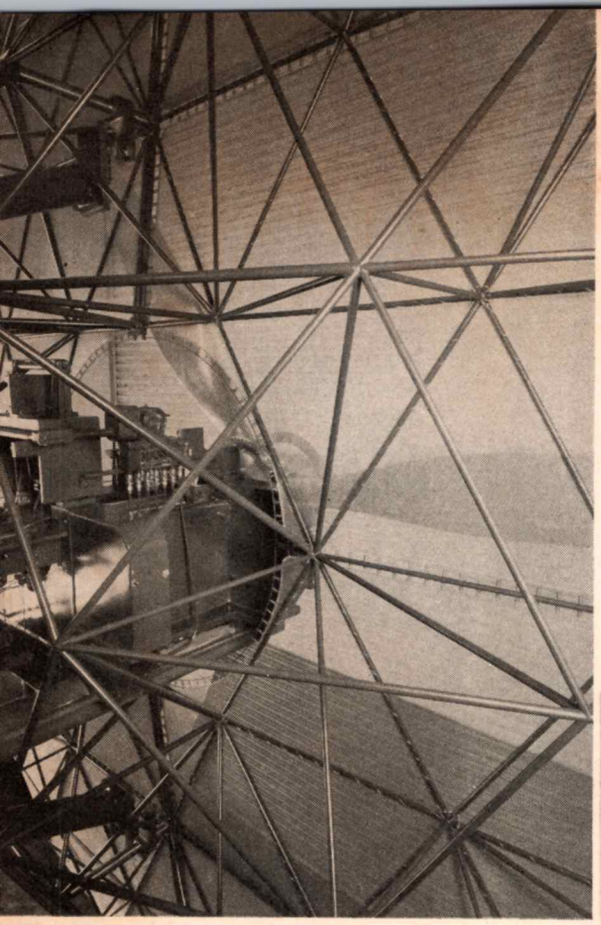
One of the limitations on speed is the compressibility shock wave which occurs when local velocities about parts of the structure exceed the velocity of sound. Since this shock wave is accompanied by an enormous increase in drag, it is an effective barrier to speed increase. There is sufficient aerodynamic knowledge to design away from this condition for some time, except in the case of the propeller where conditions may become quite critical at speeds of about 500 mph.

High altitude flying offers an attractive means of increasing speed performance because the variation in air density increases the effective speed range of the wing surfaces and because the speed increase is achieved with no increase of power. Medical research and practical experience set a limit of 35,000 to 40,000 ft. for the pilot breathing pure oxygen unless pressure cabins are resorted to. The present limit on increase of speed at altitude is set by the problems of cooling the engines and compressing and cooling the carburetor charge. Intensive work now going on may lead to radical improvements in cooling at high altitude, but cooling difficulties may remain a permanent limitation on increase of speed with altitude.

This problem will become increasingly acute at altitudes above 35,000 ft. where the temperature of the air no longer drops off with increasing altitude so that a substantial increase in radiation surface or the use of blowers will be necessary.

About the Author

Frank W. Caldwell is one of the world's foremost propeller engineers. He is Director of Research for United Aircraft Corp., and president of the Institute of the Aeronautical Sciences. A graduate of MIT (1912), he joined Curtiss Aeroplane & Motor Co. in 1916 as chief of its propeller department, but subsequently switched to the Army Air Corps to become chief of the propeller unit at Wright Field. In 1929, Caldwell became chief engineer of the Standard Steel Propeller Co., predecessor of the present Hamilton Standard Propellers Div., United Aircraft Corp., and in 1936 was appointed engineering manager of the division. His work was recognized in 1933 when Hamilton Standard received the Collier Trophy, and in 1936 when he received the Sylvanus Reed award. Caldwell has been especially prominent in the development of the Hamilton Standard Hydromatic quick-feathering propeller

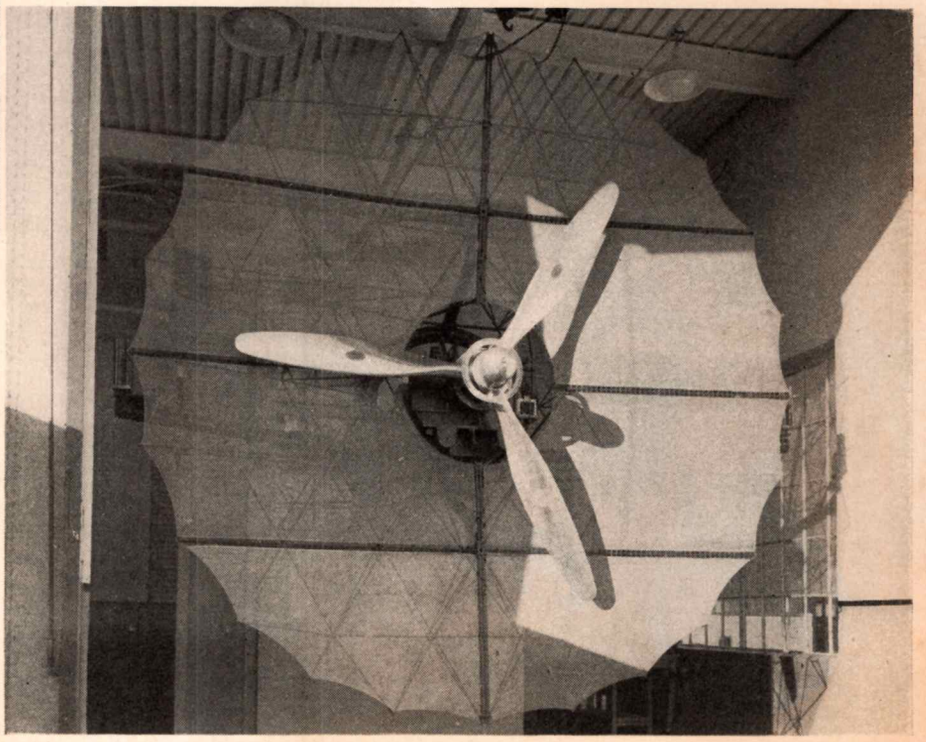


BALANCING OF AIRCRAFT PROPELLERS

(PART 3)

MURRAY C. BEEBE, Jr.

Hamilton Standard Propellers Div., United Aircraft Corp.



Front and rear views of balancing machine, showing 16′ pivoted diaphragm ready for measuring aerodynamic unbalance in an 11.5′ propeller

● Part I of this article pointed out that aerodnyamic unbalance, which is produced by unequal thrust distribution among the blades of an aircraft propeller, may be equally as important as unsymmetrical mass distribution of the propeller in producing objectionable vibration of the aircraft structure. Part II was principally devoted to a description of the equipment with which Hamilton Standard is studying the mass balance characteristics of propellers.

This part of the article outlines several ways in which aerodynamic unbalance may be measured and describes the theory and operation of the apparatus which has been selected as most suitable for measuring, on an experimental basis, the aerodynamic unbalance of production type propellers. With this equipment it is expected to establish the relative importance of aerodynamic and mass unbalance and to determine the degree of refinement with which both types of unbalance must be corrected in order to eliminate objectionable vibration of the aircraft structure.

Aerodynamic Unbalance Defined

The aerodynamic thrust moment acting upon a propeller blade may be expressed by

$$M = \int_{0}^{tip} rp\, dA \cos\alpha \quad \ldots\ldots\ldots\ldots (10)$$

where

M = moment produced by aerodynamic thrust
dA = elementary area of the blade
p = pressure acting on dA
α = angle between the blade element and the plane of rotation
r = radius to the elementary area

Normally the thrust moment acts to deflect the blade from its plane of rotation and this in turn introduces a restoring moment, resulting from action of centrifugal force on the deflected blade which tends to return the latter to its undeflected position. If these effects are neglected, the moment M represents the total moment in the thrust direction which may be attributed to aerodynamic forces.

If the moments M produced by each blade are equal, the propeller is aerodynamically balanced. If, on the other hand, inequalities in the blade angles, planforms or airfoil sections of the individual blades produce unequal thrust moments among the blades, aerodynamic unbalance results.

The unbalance effect of each blade may be considered separately or the resultant of these individual effects may be represented by a single moment vector rotating with the propeller at propeller speed. This vector may have any angular location in the propeller disc.

Determination of aerodynamic unbalance, therefore, involves the use of equipment which will measure the magnitude and angular position of the unbalance moment vector, or for greater convenience requires equipment which will indicate differences in thrust moments of the individual blades in terms of the angle corrections which may be applied to these blades to reduce the

(Continued on page 105)

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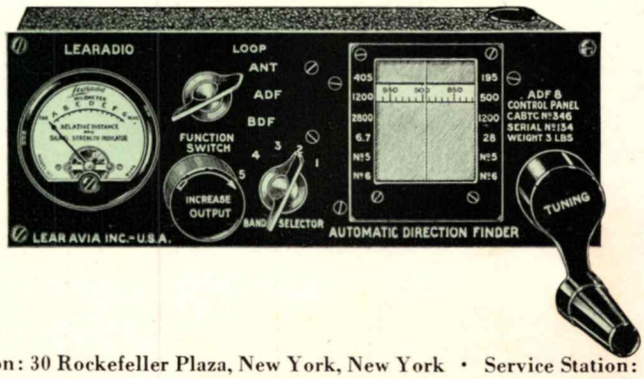

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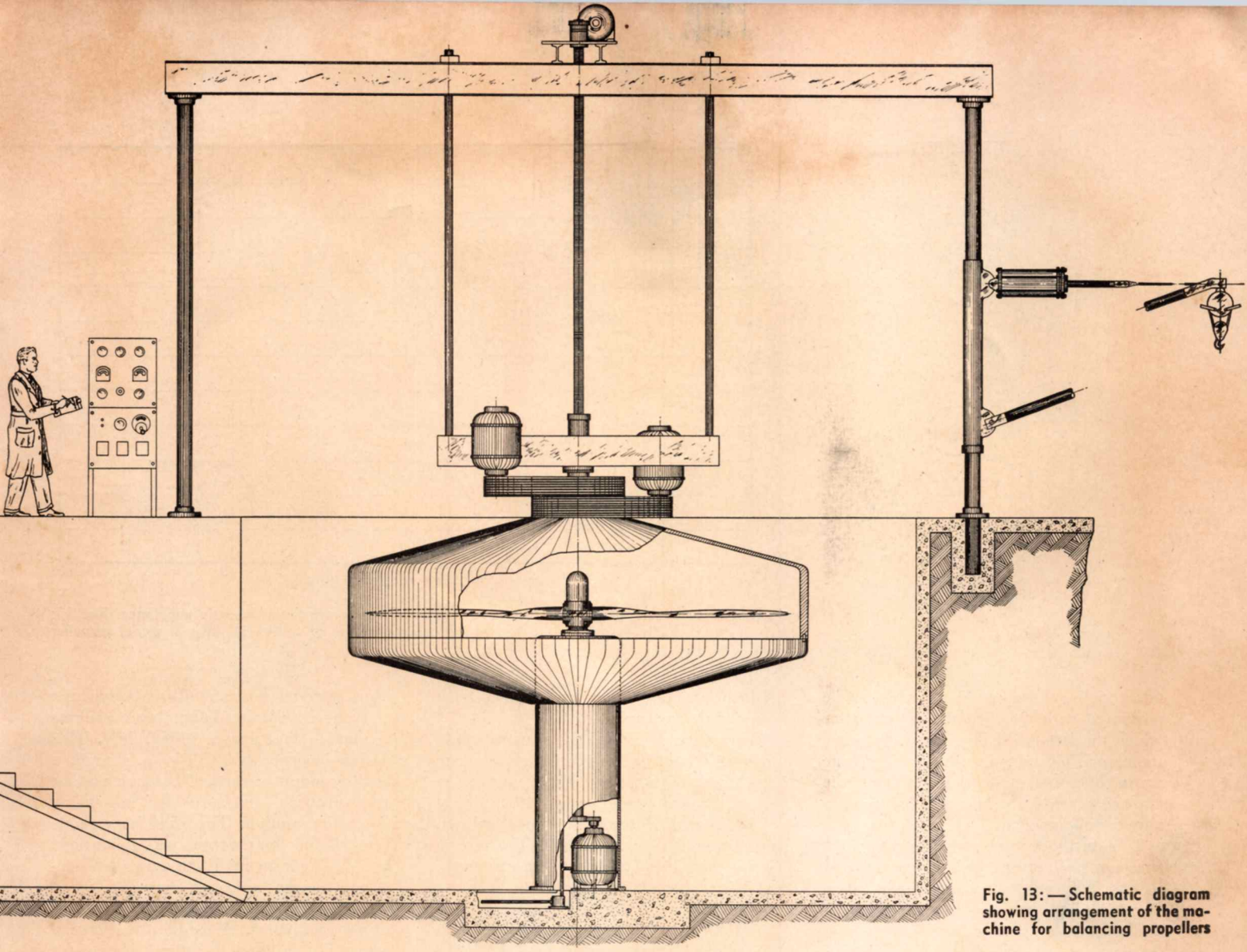


Fig. 13: — Schematic diagram showing arrangement of the machine for balancing propellers

(Continued from page 102)

thrust moment differences to zero and thus establish aerodynamic balance.

Methods of Measuring Unbalance

Four methods of measuring the aerodynamic unbalance were studied. In each of these it was assumed that the mass unbalance would be measured by a Dynetric machine or its equivalent.

Evacuated Shroud Method:—If the propeller to be balanced is mounted on a suitable dynamic balancing machine and is surrounded by a cylinder which can be evacuated to a reasonably low air density, the air forces on the blades will be reduced to a value such that any unbalance indicated by the machine will be due substantially to mass nonsymmetry of the propeller. If this unbalance is now compensated by correction weights, the cylinder allowed to reassume atmospheric density and the propeller again brought to balancing speed, the machine may again indicate that the propeller is unbalanced. As the propeller is now in accurate mass balance, this indication will represent aerodynamic unbalance which may be corrected by appropriate adjustment of the individual blade angles.

Because the accuracy of results obtained by this method would depend upon the degree of negative pressure attainable in the cylinder and more particularly because the practical problems associated with this scheme as a possible production balancing procedure seemed formidable, it was rejected.

Rotating Shroud Method:—This may be considered a variation of the evacuated shroud method. If, instead of evacuating the cylinder, it is made capable of rotating at or near propeller speed, the air forces will be effectively eliminated from the blades and the balancing procedure will be substantially as outlined for the evacuated shroud meth-

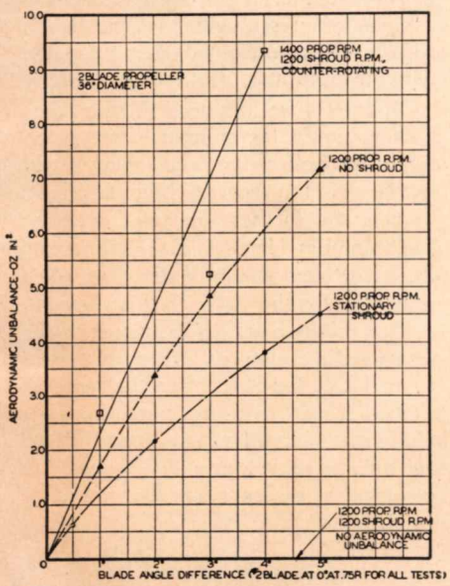


Fig. 11:—Aerodynamic unbalance caused by unequal blade angles of model propeller

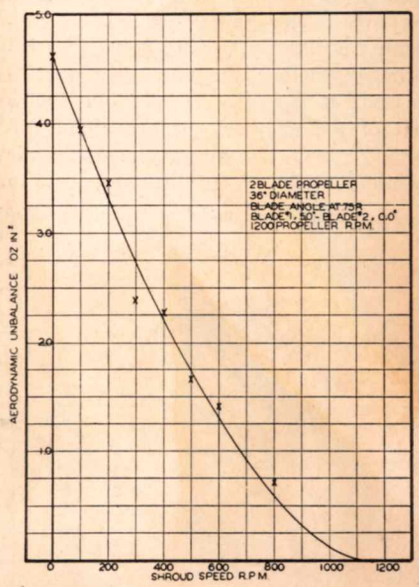
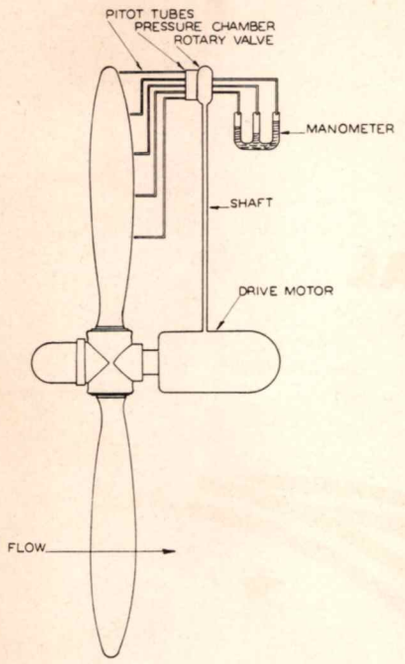


Fig. 12:—Effect of shroud speed on the aerodynamic unbalance of a model propeller



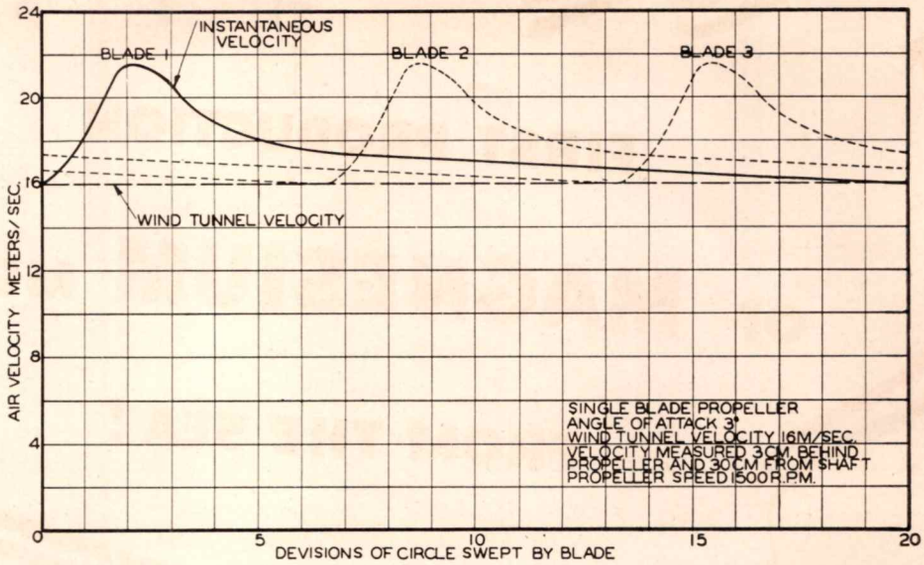


Fig. 14: left) Schematic sketch of strobometric device for measuring aerodynamic unbalance. Fig. 15: (above) Experimentally determined curve showing periodic nature of airflow in wake of model propeller

od; that is, the mass unbalance will be measured with the shroud rotating, after which the latter will be opened, the mass unbalance corrected and the machine again operated, this time without the shroud, in order to measure the aerodynamic unbalance.

This method promised accurate measurements of aerodynamic unbalance and it was believed that with proper attention to design details of the shroud, particularly to its rate of acceleration and deceleration and to its ease of manipulation, the equipment could be made suitable for production balancing should this be found necessary.

Accordingly, model tests were made with a 36″ dia., two-blade propeller running on a small Dynetric machine which was equipped with a separately driven rotating shroud. These tests were made in order to obtain empirical data for use in designing full-scale equipment. Specifically, it was desired to determine whether the shroud might be rotated at speeds considerably below that of the propeller or even held stationary, thus depending upon the air rotation produced by the propeller to reduce air forces on the blades to a reasonable minimum.

The curves of fig. 11 illustrate the magnitude of aerodynamic unbalance produced by unequal blade angles in a 36″ model propeller and the ability of the shroud, rotating at several speeds, to eliminate this unbalance. The curves show that the stationary shroud, even with polished inner surfaces, is quite ineffective in eliminating air forces from the blades as the thrust unbalance with the shroud stationary is between 60% and 70% of that present in free air. Fig. 12 illustrates the importance of shroud speed and indicates that although close synchronism between propeller and shroud is not necessary, the latter should be run at greater than 90% propeller speed to eliminate substantially all aerodynamic reactions from the blades. In figs. 11 and 12 aerodynamic unbalance has been expressed in oz. in.^{2} units; that is, in terms of equivalent mass moment unbalance. These units may be converted to lb. ft. units at any speed by multiplying them by $(rpm)^2/6.76 \times 10^6$.

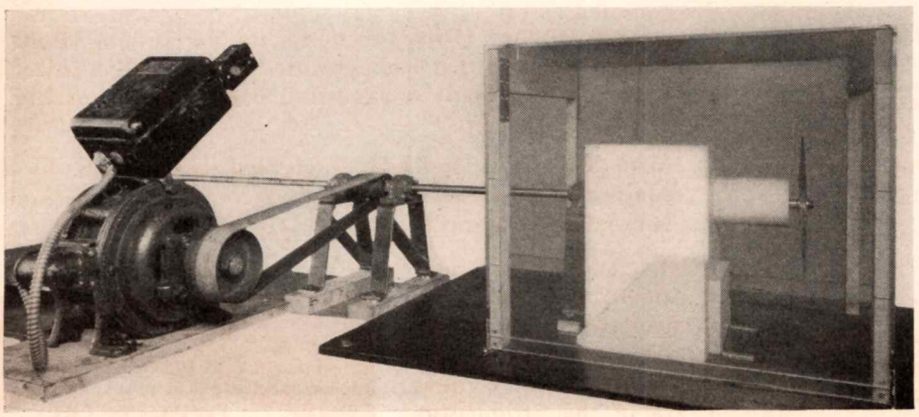
Following these tests, preliminary designs were made for a full-scale dynamic and aerodynamic balancing machine similar to that shown in fig. 13[4]. This design incorporated a 16′ dia. shroud, a flexibly mounted vertical balancing arbor and electrical networks for measuring the arbor motion. The shaft was made vertical and the machine was submerged into the floor to facilitate propeller handling. Power operated catwalks (not shown in the drawing), provided access to the propeller. Although this design admirably fulfilled the requirements for rapid manipulation of the shroud, certain unavoidable complications were present and it appeared desirable to investigate possible simpler methods for measuring aerodynamic unbalance before proceeding with its detail design.

Strobometric Pressure Method:—An analytical study of a method of indicating aerodynamic unbalance by the measurement of pressure fluctuations in the propeller wake indicated that this plan might be used successfully.

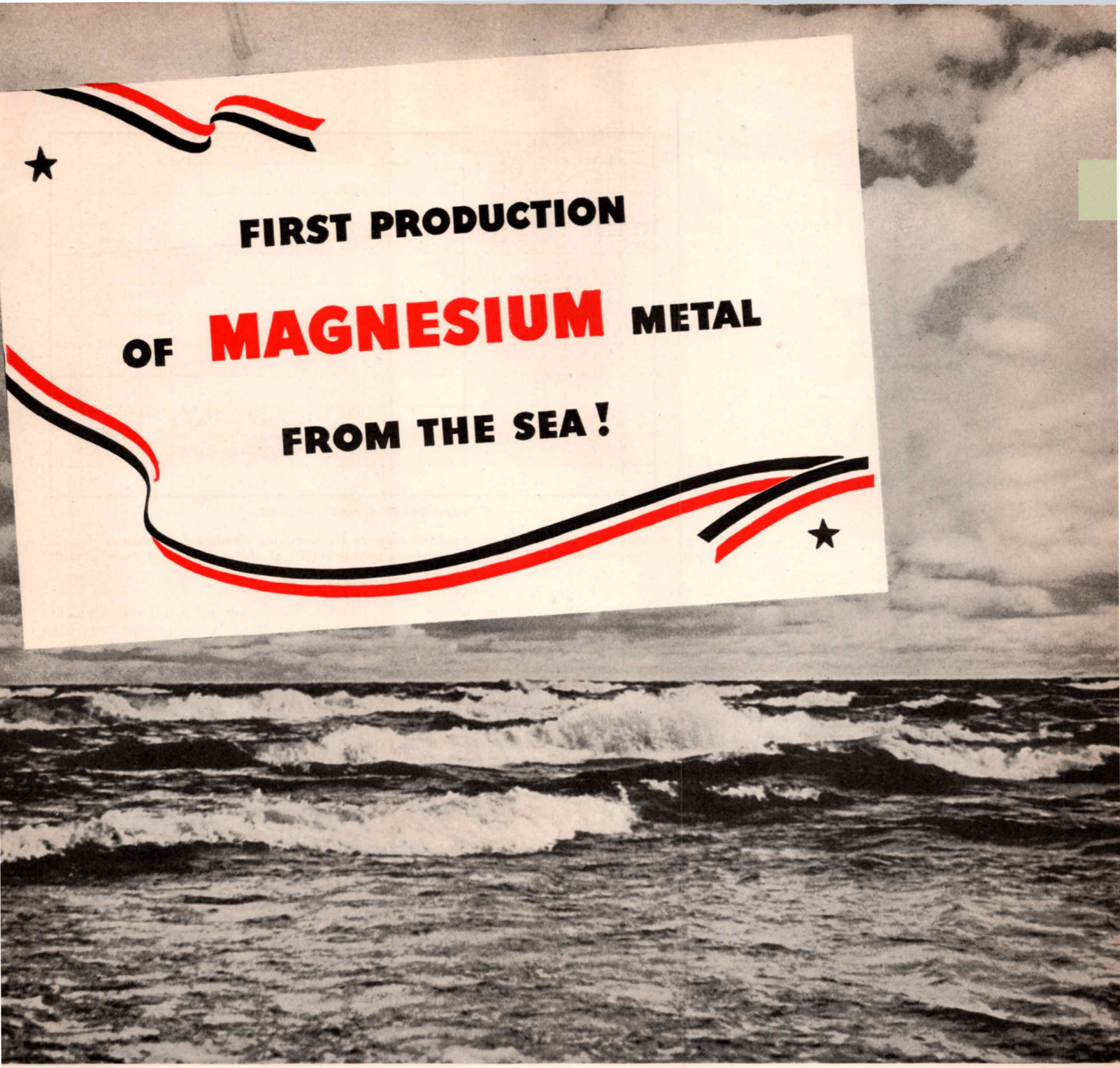
The total pressure head is the same at all points in the column of air entering the propeller, its value being equal to that of the surrounding free air. Further, the increase in total pressure of any annular element of the slipstream passing through the propeller disc, when multiplied by the area of this element, is substantially equal to the thrust of the corresponding element. Thus, if means are available for measuring the increase in total head at a number of points behind the propeller, over that of the free air, these pressure differences can be made a measure of the propeller thrust.

(Continued on page 109)

Half scale model of balancing machine and chamber for smoke filament tests



[4] Machine designed by Baker Manufacturing Co., Evansville, Wis.



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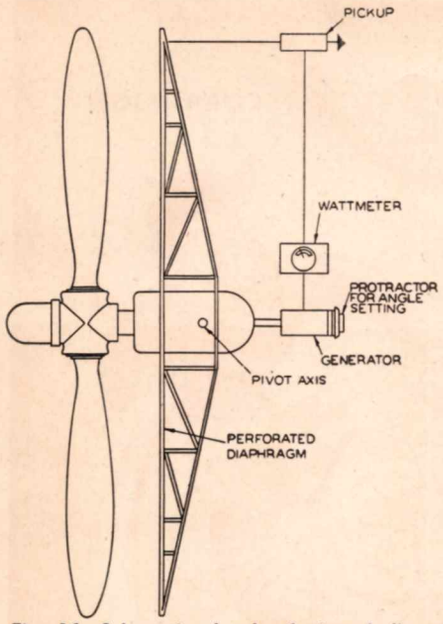


Fig. 16: Schematic sketch of pivoted diaphragm for measuring aerodynamic unbalance

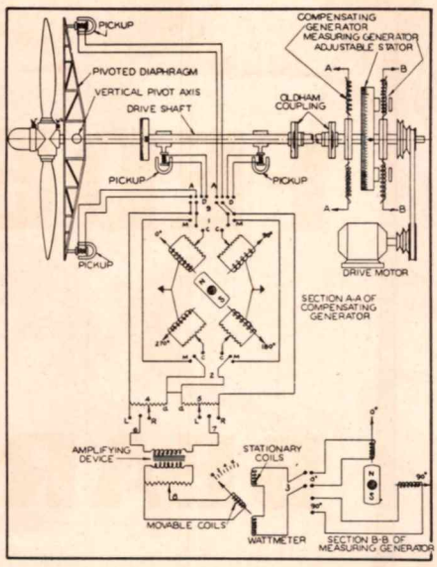
(Continued from page 106)

Fig. 14 illustrates diagrammatically a device for measuring the pressure differences developed behind each individual blade of a rotating propeller by means of a series of pitot tubes located in the propeller wake and connected through a common pressure chamber and rotary valve to the legs of a multiple manometer—one leg for each blade. The rotary valve is synchronized with the propeller and is so constructed that it permits instantaneous communication between all of the pitot tubes and the manometer leg for a particular blade only when that blade passes the tube openings. The differences in readings of the individual manometer legs will then represent differences in thrust moments of the corresponding blades and will be a measure of the blade angle corrections necessary to produce aerodynamic symmetry. In order for the above to be true it is necessary that the diameters of the pressure tubes be adjusted so that their flow characteristics will be properly related to the distances from the tube openings to the axis of rotation. Only under this condition will the indication of the apparatus approximate the true blade thrust moment; that is, a summation of the products of the pressure on the elementary areas and the distances of these elements from the moment axis.

To illustrate the periodic nature of airflow behind the propeller, which forms the basis for this method of thrust unbalance measurement, the curve of fig. 15, taken from Drzewiecki[5], is presented. The data for this curve were obtained strobometrically from a single-blade model propeller running at 1500 rpm in a wind tunnel with an air speed of 16 meters per second. The angle of attack was 3°. A pitot tube was located 3 cm. behind the propeller and 30 cm. from the shaft and was connected with the manometer through a rotary valve which was synchronized with the propeller. Superimposed on the original curve are dotted curves representing the additional components of a three-blade propeller.

Estimates of the peak velocity differences to be expected behind blades whose angles vary by 0.1° show that at a balancing speed of 600 rpm and a blade angle of 10° at .75R these correspond to pressure differences of the order of 0.01″ of water. These pressure differences appear difficult to measure accurately even with sensitive manometric equipment.

Although this method presented interesting possibilities, it promised also to involve a somewhat lengthy development program and was therefore abandoned, at least temporarily, in favor of the following method.



Pivoted Diaphragm Method: — This method, illustrated in fig. 16, also utilizes pressure fluctuations in the wake of the propeller to indicate variations in blade aerodynamic moments. It consists of mounting a large, pivoted, nonrotating diaphragm behind the propeller and measuring the magnitude and phase of its oscillatory motion which is produced by the unsymmetrical air flow from an aerodynamically unbalanced propeller.

The diaphragm is acted upon by moments from the individual blades which may be expressed by an equation similar to Equation (10). In this case p represents the pressure on an elementary area dA of the diaphragm located at a distance r from the pivot axis and $\cos \alpha$ drops out because α is always zero.

It is evident that the oscillatory motion of the diaphragm will be proportional to the difference in the thrust moments of the individual blades and will be resisted by the inertia of the diaphragm structure. A preliminary study of this method indicated that it would be convenient to measure this motion with electrical pickups used in conjunction with the electrical equipment already available in the Dynetric machine. It appeared also that this method presented the simplest means of those studied for measuring unbalanced thrust with adequate accuracy. Accordingly, a full-scale machine was constructed which is capable of balancing propellers up to 16′ dia. and which is suitable for attachment directly to the Dynetric machine[6].

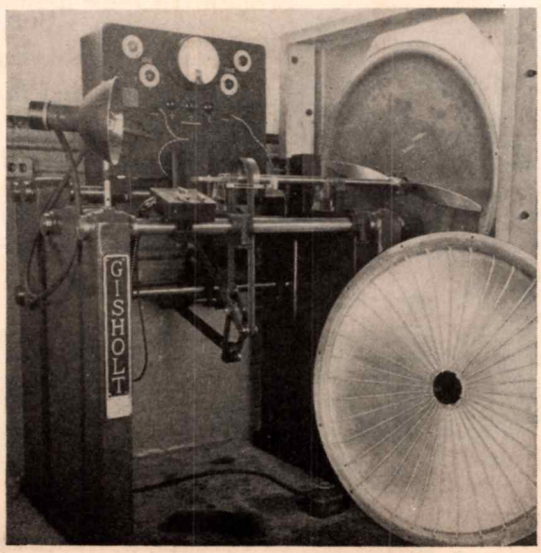
A front view of the diaphragm attached to the Dynetric machine as shown in an accompanying illustration, as is a view from the control room of the machine showing the supporting structure

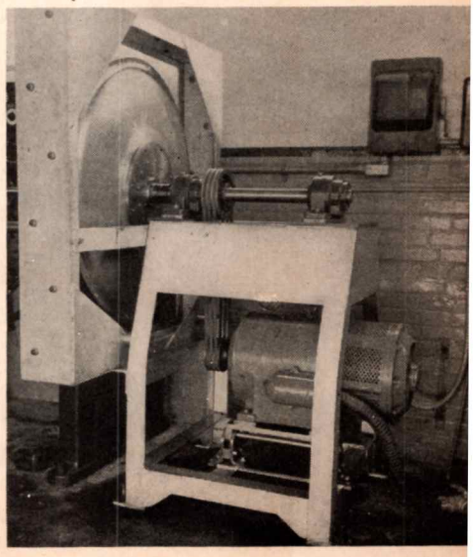
(Continued on page 193)

[5] Theorie Generale De L'Helice, S. Drzewiecki, Gauthier-Villars, Paris, 1920.

[6] This equipment designed and manufactured by the Baker Manufacturing Company, Evansville, Wis.

Fig. 17: (above) Diagram of the essential components of the balancing machine. Below is shown the model equipment for testing ability of rotating shroud to eliminate aerodynamic unbalance





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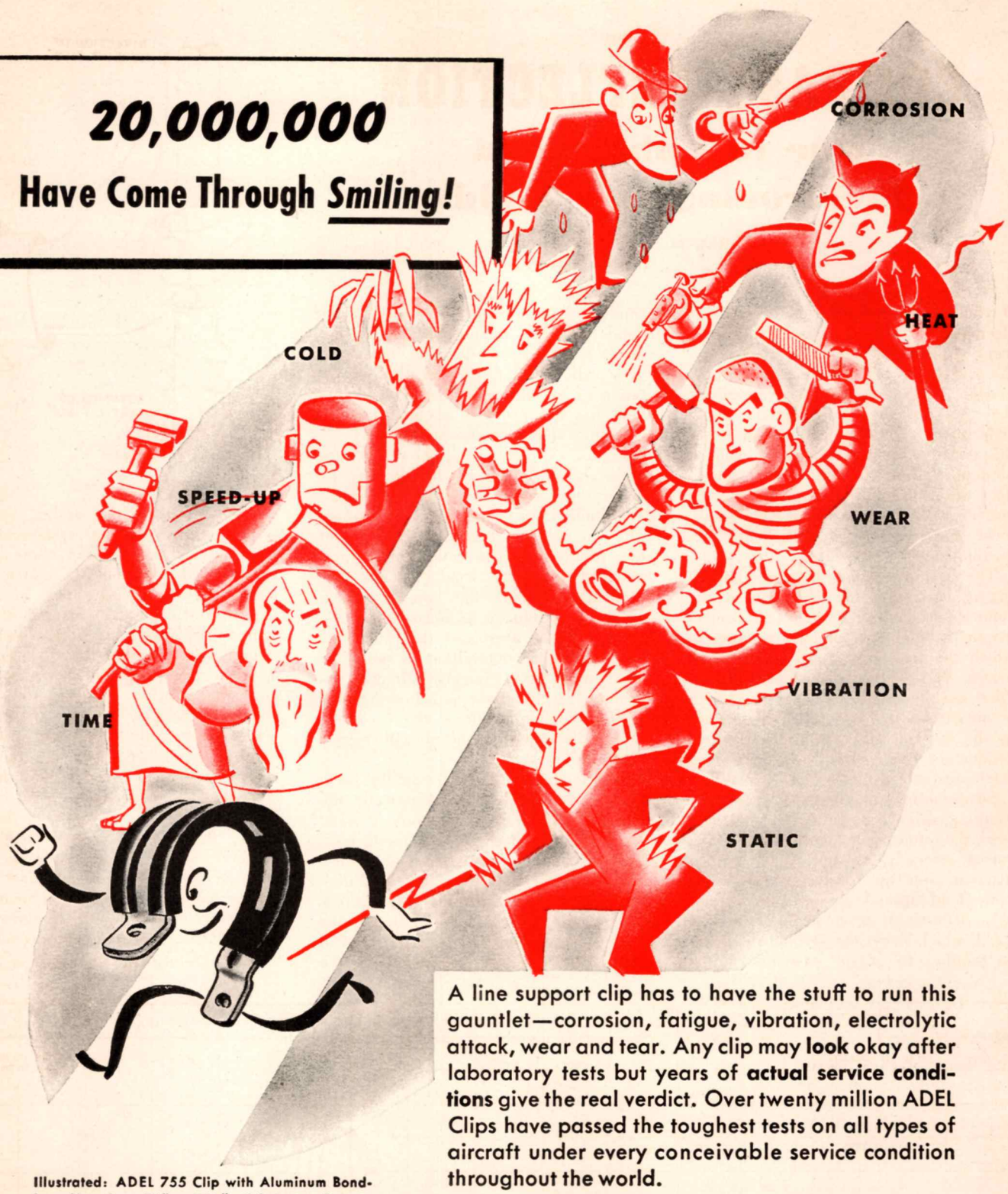

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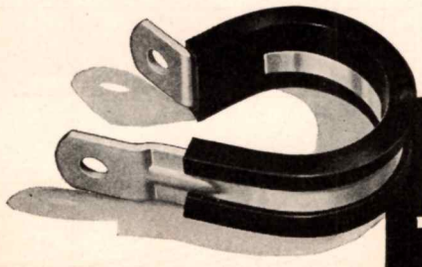

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COMPASS DEFLECTION

Due to Unbalanced Electromagnetic Fields

NORMAN J. CLARK
Engineering Dept., Lockheed Aircraft Corp.

● The ever-increasing use in aircraft of electricity for power, control and instrument applications has had an effect on the deflection of a magnetic compass needle. Deflection may be caused by the presence of ferro-magnetic materials in the vicinity of the compass, but this is not of serious import in modern aluminum alloy aircraft. Where trouble does occur from this source, it may be remedied by compensating with small, loose magnets and by periodically demagnetizing the structure.

The vital problem is that of eliminating or correcting for deflection of the compass needle brought about by electromagnetic fields surrounding conduits in which the electric currents are not balanced. By unbalanced current is meant "that portion of the total current which is not neutralized by an equal current in the opposite direction, with the two conductors arranged so as to provide a minimum external effect."

Surrounding any electrical conductor carrying direct current, is a magnetic field, the intensity or amplitude of which varies inversely as the square of the distance from the conductor. This magnetic field around a conductor rotates in a definite direction, as illustrated in fig. 1, which shows the "right hand rule" so familiar to physics students. If the conductor is grasped with the right hand, with the thumb pointing in the direction of current flow, the other fingers will indicate the direction of rotation of the electromagnetic field. This field has the property of attracting or repelling any magnetic substance.

Figs. 2 to 4, inclusive, show just how great the deflection magnitude may be under the various conditions of current amplitude and conductor disposition. The curves show that the deflection of the needle will be much more pronounced when the conductor cuts the vertical plane of the compass, than when the conductor is horizontally disposed. Fig. 1 illustrates this phenomenon, indicating that although the force is equally great in any direction, a compass needle above or below the wire will be rotated, while if the needle is in the horizontal plane it will merely dip.

Due to the limited space in the cockpit of an airplane, it is practically impossible to route the conduit at sufficient distances from the magnetic compass to eliminate any chance of electromagnetic deflection. Some other solution must be discovered, and several methods suggest themselves to the designer, the choice of which will usually depend upon other factors concerned in the layout of a particular design.

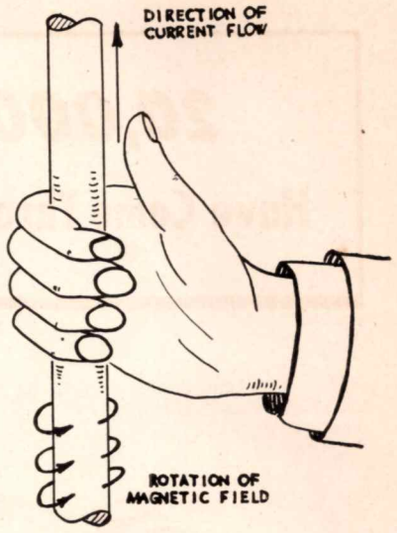

Figure 1

A complete two-wire system of electrical circuits may be used; some aircraft operators demand such a system. This system has the disadvantage of requiring a much greater amount of wire, which increases both weight and cost. This increase in material is due not only to the extra lengths of conductor to replace the structure as a negative return, but also because of the larger wire gauges required to prevent excessive voltage drop caused by the increased circuit lengths. It is clear, too, that the diameters of all conduits would have to be increased. It is assumed, in the foregoing, that the ohmic resistance of the structure would be negligible, as is the case in a well-bonded airplane. Experience has shown that a combination of a two-wire system for the circuits in the flight station and the more economical

(Continued on following page)

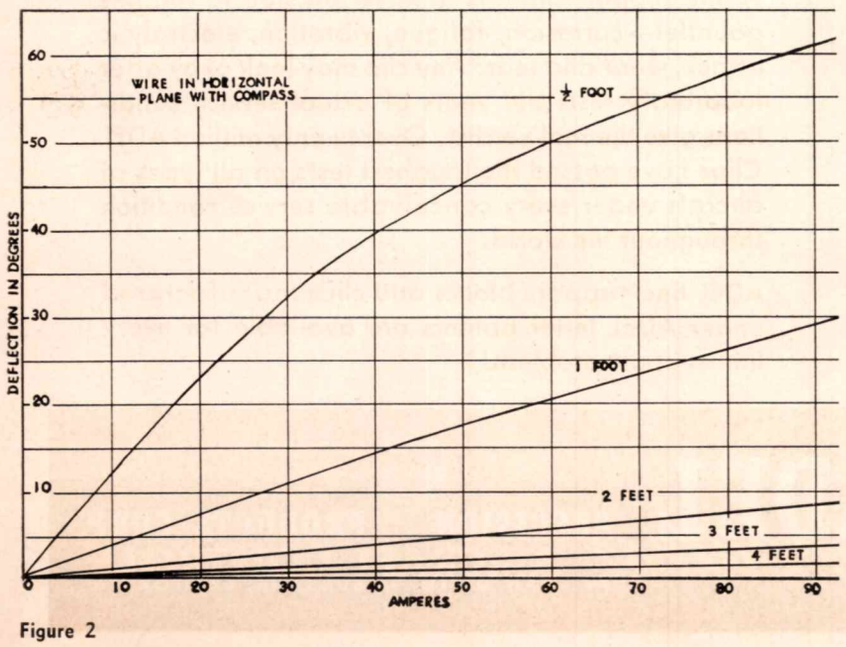

Figure 2

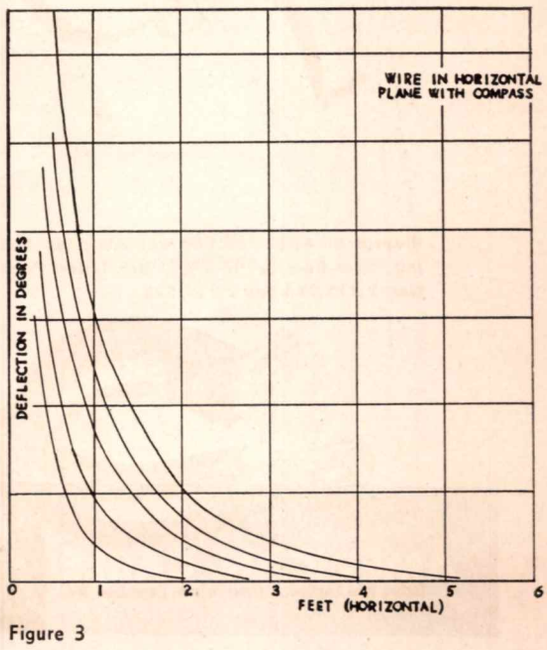

Figure 3

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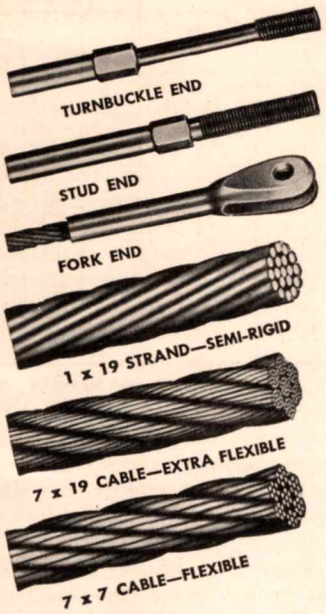
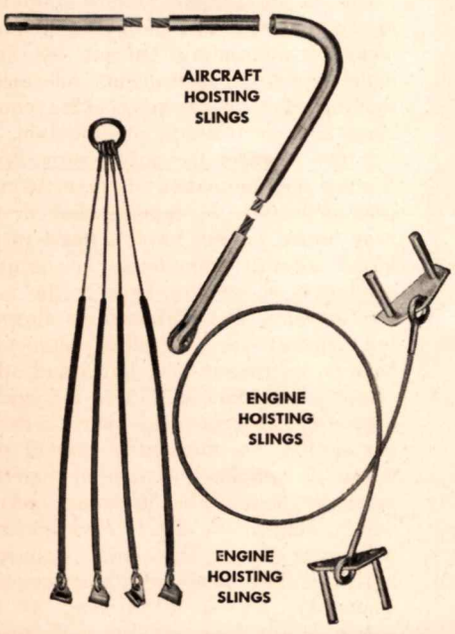
AIRCRAFT CONTROL EQUIPMENT





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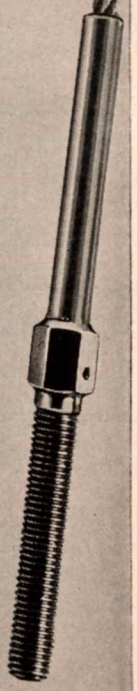


AMERICAN CABLE "Korōdless" AIRCRAFT CONTROLS

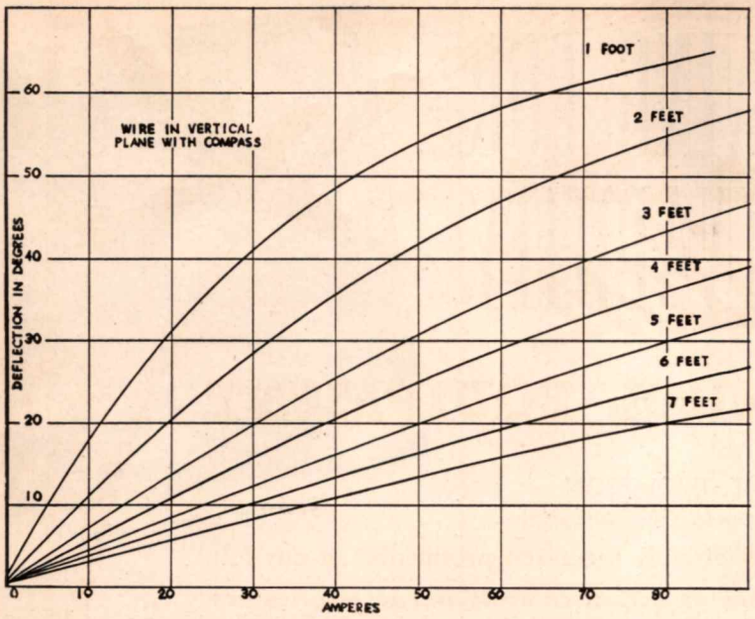


Figure 4 (above)

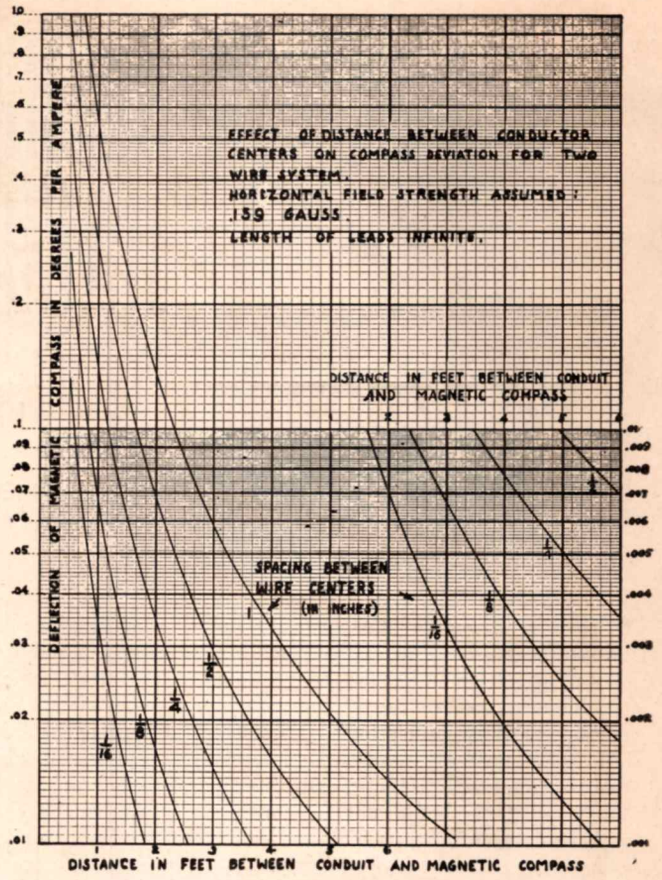

EFFECT OF DISTANCE BETWEEN CONDUCTOR CENTERS ON COMPASS DEVIATION FOR TWO WIRE SYSTEM.
HORIZONTAL FIELD STRENGTH ASSUMED: .159 GAUSS.
LENGTH OF LEADS INFINITE.
DISTANCE IN FEET BETWEEN CONDUIT AND MAGNETIC COMPASS
SPACING BETWEEN WIRE CENTERS (IN INCHES)
DEFLECTION OF MAGNETIC COMPASS IN DEGREES PER AMPERE
DISTANCE IN FEET BETWEEN CONDUIT AND MAGNETIC COMPASS

Figure 5 (right)

(Continued from preceding page)

single-wire system for other parts of the ship is feasible where direct current must be used.

Such items as landing gear and wing flap motors and landing lights, while drawing considerable current, generally may be disregarded as contributors to compass deflection, as they normally are not energized when the compass is being used. Yet, these high currents may permanently magnetize any ferrous metals in their vicinity, or in the vicinity of the compass. During the layout of fuselage structure drawings, it must be remembered that most customers have their own ideas about compass location. Therefore, brackets, clips, gussets and stiffeners in the flight compartment should be made from non-magnetic materials where possible.

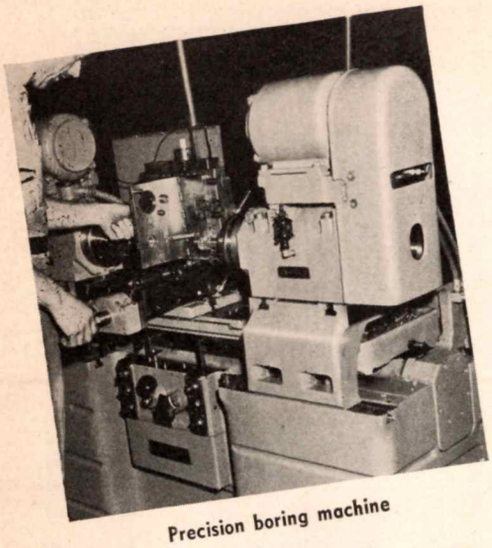
Even with a complete two-wire system, there will be a certain degree of current unbalance, producing some magnetic field in the area around the conduit. This is caused by the distance separating the centers of the conductors constituting a specific circuit. The curves in fig. 5 illustrate the magnitude of compass needle deflection to be expected under various conditions of center-to-center distances and current amplitudes. In this regard, it must be kept in mind that the "shielding" offered by aluminum alloy conduit is electrostatic, not electromagnetic, and furnishes no protection from magnetic compass deviation. To be certain of eliminating all effects of an external magnetic field when direct current is used as a source of electric power, several expedients suggest themselves. Of four that are most obvious, not one is, at present, economically feasible. The most common method is the transposing, or twisting together of each pair of wires constituting a given circuit. The principal objections to this practice are the additional space required in the electric conduit and the extreme difficulty of removing these twisted conductors in maintenance work.

Another remedy by which the magnetic field might be balanced would call for the use of concentric conductors. This form would be excessively bulky and costly. A third method that might have some merit in aircraft is suggested by small marine installations. This is the compensating coil, installed on the opposite side of the magnetic compass from the main conductor run, and in which a specific small portion of the total current is flowing. By experimenting, the proper number of wire turns could be found to adequately balance the compass. The current in the compensating coil need not be great, as the turns could be calculated to provide the ampere-turns necessary to furnish the same external field as the straight conductor on the opposite side of the compass.

The most remote remedy for compass deviation in a direct current installation, would be to use, in the cockpit, a conduit of high magnetic permeability. The permeability ratio of ordinary soft iron is around 3100. That is, it has 3100 times the permeability or magnetic conductance of dry air. The present trend in magnetic alloys, such as Permalloy and Alnico, tends to indicate the introduction in the not-too-distant future, of alloys possessing permeability ratios of approximately 2000 which might come close enough, in thin-walled tubes, to the weight of aluminum to be considered for conduit applications in aircraft. Obviously, however, this material, being magnetic (by virtue of which property it would provide electromagnetic shielding for the compass) it would soon become a permanent magnet itself, and so further deflect the needle.

One factor, however, offers a solution to the problem. The increasing requirement of alternating current for such items as autosyn instruments, fluorescent lighting, electric razors, cooking equipment and electrostatic precipitation, offers the engineer the only positive solution for the elimination of magnetic compass deflection. It appears that in the near future we will have, at least in the larger aircraft, completely ac-equipped airplanes, as we now have in the military services. The utilization of alternating current for operating pitot-static heaters, instrument ring lights and other compass deflectors will afford the needed protection. At frequencies above 25 cycles per second, an alternating current produces a completely balanced external magnetic field. Also, it cannot permanently magnetize any ferrous material within its range. This lower frequency limit coincides nicely with other requirements for an ac installation, as the weight of electrical equipment decreases quite rapidly with increase in frequency.

When starting on a new design project, the problem of compass deflection should be considered as a factor in choosing the type of electrical power source to be used.

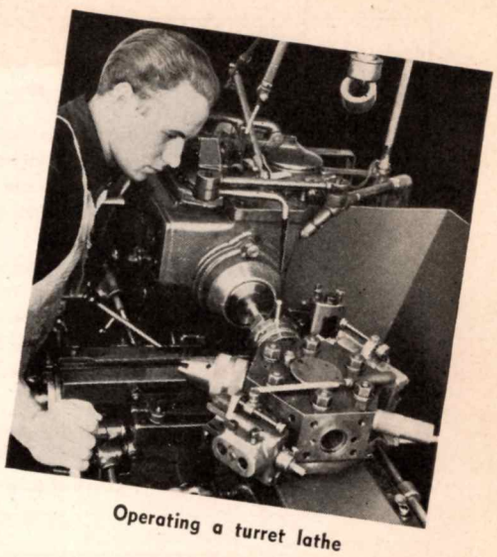


Precision boring machine

DESIGNING FOR MACHINABILITY

[PART 2]

JAMES E. THOMPSON
Specification Engineer, Vultee Aircraft, Inc.



Operating a turret lathe

● Turning is one of the simplest and one of the most useful of the machining operations. It includes the conventional turning of outside diameters, and internal turning or boring in which an existing hole is enlarged by an adjustable cutting tool provided with a single cutting edge. This operation should not be confused with counterboring, in which the end of a hole is enlarged cylindrically by a counterbore cutter, as in forming the recess for a fillister-head machine screw.

Boring is necessary where internal turning is required, and is employed: (1)—where it is necessary to have a straight true hole; (2)—where the inside diameter of a hole must be concentric with the outside diameter; (3)—where it is necessary to provide a thread relief at the inner end of an internal thread; and (4)—where an internal shoulder must be formed.

Turning and boring are done on some form of lathe, such as an engine lathe, turret lathe, screw machine, or boring machine. The principle of all these machine tools is identical in that it involves the generation of surfaces by rotation between the work and a cutting tool. While plane and cylindrical surfaces can be generated with ease, this is not true of work which involves the shaping of less than a complete circle. General design considerations for turned and bored parts will always apply, regardless of the machine tool used for actual production.

The more common design errors which affect the economy of turned parts result from the belief that hollow or tubular turned parts should be machined from heavy-wall tubing. Actually, this is more expensive than "hogging-out" the part from solid bar, unless the material to be removed from the outside diameter is so small that centerless grinding is feasible. Solid bar is relatively cheap, because of the simplicity of producing bar forms, while heavy gage tubing is comparatively expensive. Even when it is necessary to drill and bore out large openings, leaving a relatively thin wall and wasting perhaps 75% of the material, it is often cheaper to machine the part from bar stock.

Turning and Boring Design Practice

In order to obtain production economy, a part requiring turning and/or boring operations should be designed with regard to the following basic factors: (1)—provide turning centers, either in the piece itself or in additional stock at the ends which can be machined off after turning is complete; (2)—favor the use of undercuts, rather than closely dimensioned radii, at shoulders where clearance is required for a mating part; (3)—use a spherical radius where it is necessary to turn the end of a part to a radius; (4)—minimize shoulder diameters to reduce the amount of metal to be removed; (5)—avoid the use of long, slender turned or bored parts, particularly long bored tubes; (6)—avoid boring in recessed holes; (7)—allow adequate material to "clean-up" when turning or boring is required after heat-treatment; and (8)—use standard raw stock sizes in order that the amount of metal removed may be reduced to a minimum.

Turning Centers:—Pieces which require turning or grinding between centers should have the centers specified, and shown either by dotted lines on the draw-

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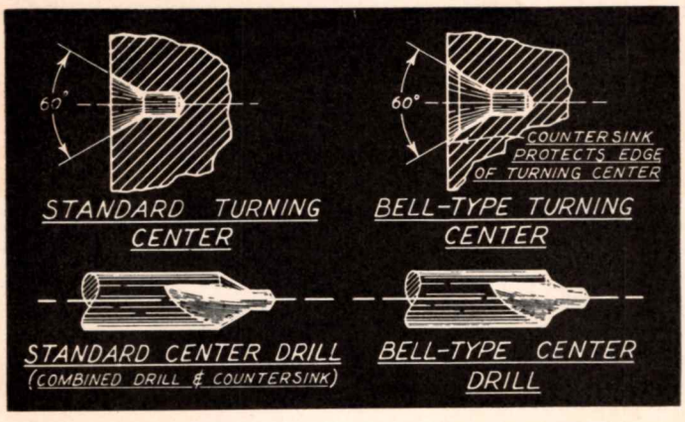

Fig. 8: (above) Standard and bell-type center drills

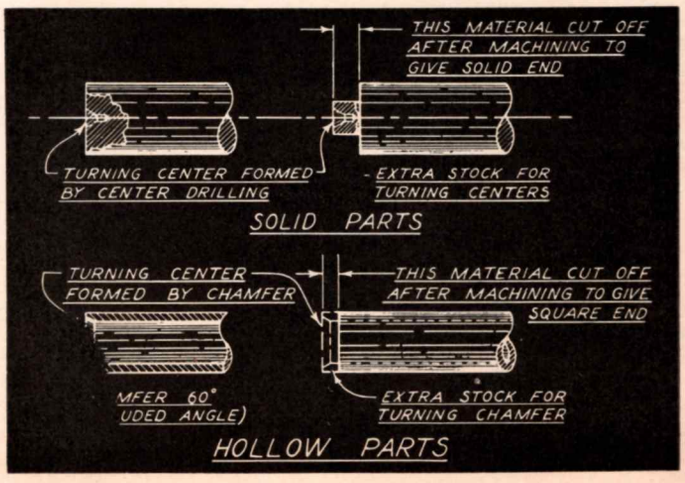
THIS MATERIAL CUT OFF AFTER MACHINING TO GIVE SOLID END
TURNING CENTER FORMED BY CENTER DRILLING
EXTRA STOCK FOR TURNING CENTERS
SOLID PARTS
TURNING CENTER FORMED BY CHAMFER
THIS MATERIAL CUT OFF AFTER MACHINING TO GIVE SQUARE END
MFER 60° UDED ANGLE)
EXTRA STOCK FOR TURNING CHAMFER
HOLLOW PARTS

Fig. 9: (right) Use of turning centers and chamfers

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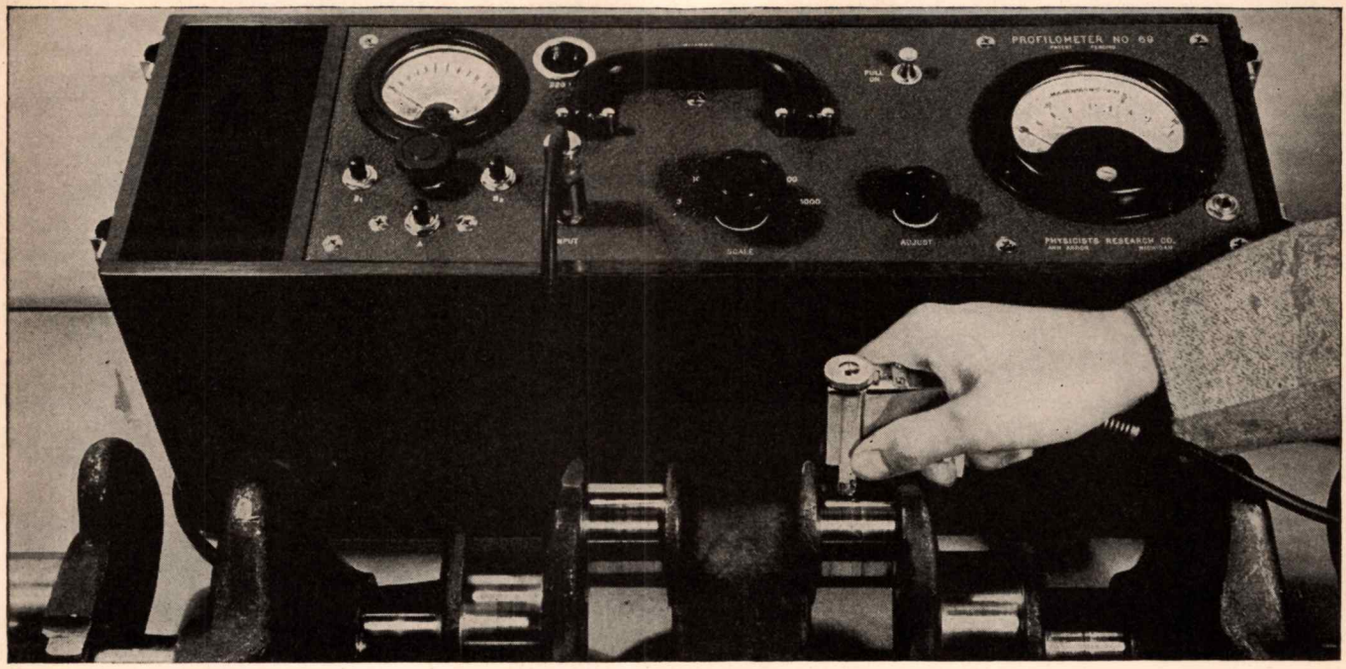

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(Continued from preceding page)
ing where these remain in the finished part, or by phantom lines where they are to be cut off after finishing. It is preferable to have the turning centers remain in the finished part to facilitate inspection, and possible re-machining.

Turning centers are required only on parts which it is known will be turned between centers. Many turned parts, such as those produced by turret lathes and screw machines, do not require centers (or at most, a center at one end) as the stock is fed through the spindle and gripped by the collet.

Solid parts are center-drilled to provide turning centers; hollow parts are usually provided with chamfered ends as turning or grinding centers. When centers are not specified for solid parts it is accepted shop practice to form the centers by allowing additional stock at the ends of the part. The turning centers are removed as the final machining operation on the part, by cutting off the excess stock allowance. This destroys the turning centers, making inspection difficult and reworking sometimes impracticable, as it would be necessary to make special fixtures to rework the parts which have lost their turning centers.

When it is necessary that the end of the finished solid part present an unbroken surface, or when the end of a hollow part must be perfectly square (not chamfered), the turning centers are provided in extra stock, and then machined off. As this involves stock waste and additional machining, it is always desirable to provide turning centers as part of the design.

Conventional center-drills consist of a short pilot drill provided with an integral 60° countersink, and are available in the following standard dimensions:

Countersink Dia.	Pilot Drill Dia.
1/8"	3/64"
3/16"	1/16"
9/32"	1/8"
13/32"	5/32"

Another form of center-drill, known as the bell-type, is sometimes used on parts which must pass through a number of subsequent handlings during machining. In these cases, the bell-type center-drill is valuable to prevent marring the edge of the turning center during handling.

When a hole is chamfered for use as a turning center, the minimum chamfer diameter should be according to the following table:

Hole Dia.	Minimum Chamfer Dia.
Up to 1/2"	Hole dia. + 1/16"
Over 1/2" to 1"	Hole Dia. + 3/32"
Over 1" to 1 1/2"	Hole dia. + 1/8"
Over 1 1/2" to 2"	Hole dia. + 3/16"
Larger than 2"	Hole dia. + 1/4"

The standard included angle for turning center chamfers should be 60° in order to match the standard taper used for lathe tailstocks.

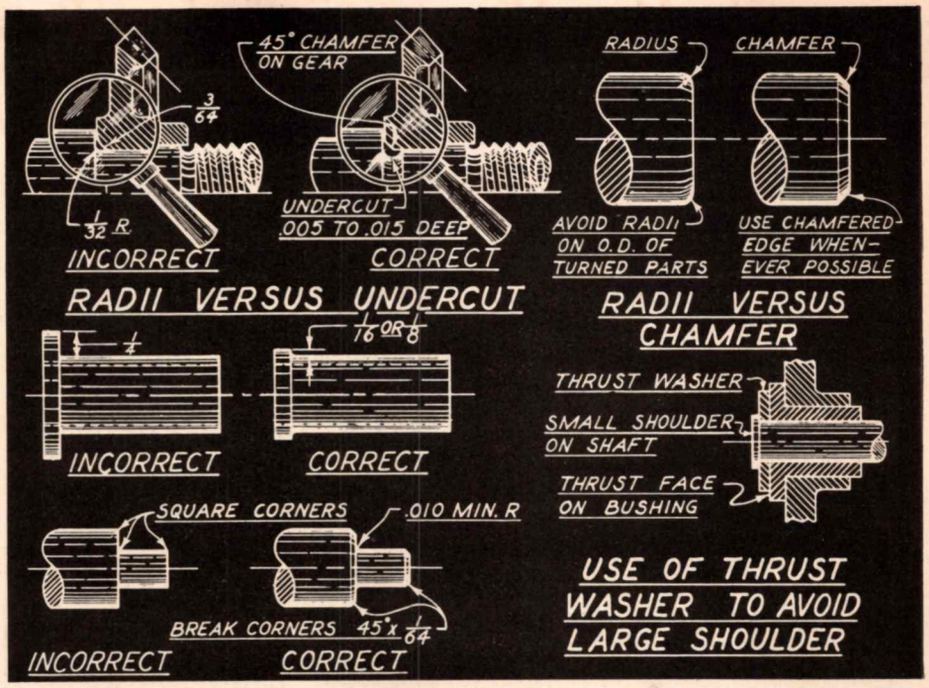


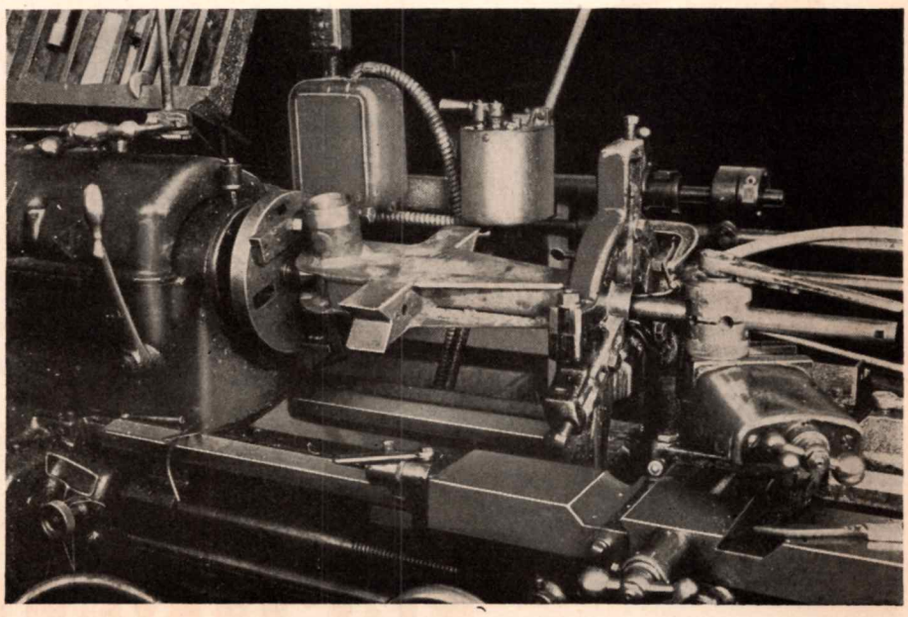
Fig. 10: Undercuts and radii for shoulder parts

Radii and Shoulders:—Undercuts can frequently be used advantageously in reducing machining and assembly expense, by avoiding the necessity of machining mating radii to close tolerances. In fact, it is recommended that undercuts be used in preference to radii where strength requirements permit.

In one of "incorrect" diagrams in fig. 10 is seen a 1/32 radius at the shaft shoulder to accommodate a bevel gear hub, and a mating radius of 3/64 on the internal diameter of the gear hub. Theoretically, the specified radii should permit assembly without interference between the radii—but in practice, manufacturing tolerances will frequently accumulate, rather than balance, resulting in interference between the mating radii. This can be eliminated only by holding the radii to close decimal tolerances, at an increase in production time and expense.

When the part is undercut, there is no possibility of interference, and production is expedited since undercutting is not only a simple turning operation, but ordinarily it need not be held to close tolerances.

When it is necessary to form the end of a turned part to a radii, this should be planned as a spherical radius equal



Shock absorber cylinder being bored in an angle lathe

to ½ the stock diameter, since this is the easiest to turn.

The diameter of shoulders or flanges on turned parts should always be held to a minimum to reduce the amount of metal that must be removed to form the shoulder. Always analyze the function of the shoulder, and reduce the diameter to a minimum which is practicable for the given function. This will effect appreciable savings in weight, material and in machining costs.

Where a large shoulder effect is essential for adequate bearing area, as in the case of a shaft-end shoulder turning against a soft material under considerable thrust load, it is often possible to obtain the required bearing by using a small shoulder and a steel washer.

In cases where an undercut is not used, it is necessary to provide a small radius at the root of a shoulder to facilitate the machining. This radius should be given as large a tolerance as possible to avoid frequent dressing of the corner of the cutting tool. In general, such corner radii should be specified for a certain minimum value (such as 0.010 *min.*), and thus carry the normal drawing tolerance. Never specify a perfectly square corner, without radius, for the root of a shoulder, because this is an extremely difficult machining operation; an undercut should be used when clearance requirements demand the effect of a square corner.

Avoid designs where long, slender members require turning, particularly where it is desirable to hold the dimensions to close limits. Such parts tend to deflect during turning, and only fine cuts may be taken—with the result that production costs are high. Such parts can be produced with a high degree of accuracy on the centerless grinder, but if a rather large thickness of metal has to be removed, it necessitates rough turning, followed by finish grinding, with increased cost.

Boring:—Avoid deep boring operations on tubes, because this is a difficult machining operation. Tubing as received

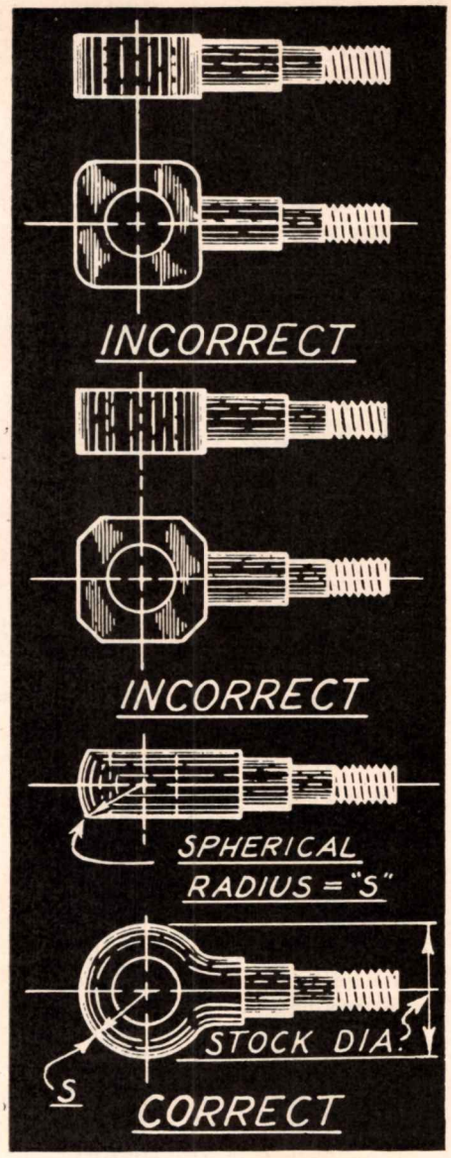


Fig. 11: Use of spherical radius

from the manufacturer is frequently bowed, out-of-round, non-concentric, and may have varying wall thickness along its length. An examination of standard tubing tolerances will show that with all tolerances at their worst condition, an unsatisfactory piece of tubing is possible —one which will require considerable machining to clean-up. Sufficient stock in the form of additional wall thickness must be provided for all bored tubes, to insure 100% clean-up.

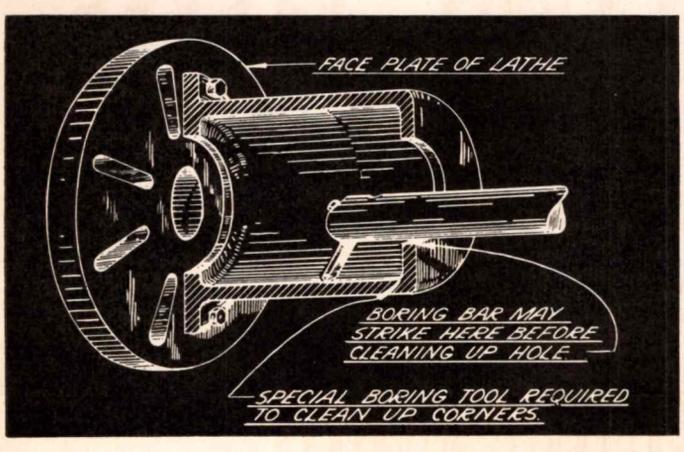
Parts requiring boring in recessed holes should be avoided whenever possible, because a special cutting tool must be used to avoid interference between the boring bar and the end flanges. Further, the lathe operator has difficulty in determining where and how the tool is cutting, in measuring the diameter of the hole, and in removing the chips to prevent clogging and deflection of the boring bar.

Machining After Heat-treatment:—Heat-treatment always causes scaling and distortion, and all finish machining must be done after heat-treatment. In the case of slender members, the distortion may be extensive, and require the removal of a considerable amount of metal. As a general rule, the softer the metal, the less expensive the machining. Therefore, the metal should be left as soft as practicable for finish machining. In all cases, sufficient stock must be allowed to permit perfect clean-up after heat-treatment. All surfaces should be provided with a minimum of 1/32 of metal for clean-up; 1/16 is preferable.

No rules can be established for the probable amount of distortion resulting from heat-treatment. That can be judged only after lengthy experience. For this reason, the heat-treatment source should always be consulted to determine probable distortion of slender and/or involved parts which require finish machining after heat-treatment.

Standard Stock Sizes:—The use of standard raw stock sizes should be a matter of careful consideration. This is particularly true with shafts which must be turned from bar stock, as in almost every case a suitable diameter bar for the purpose can be selected from standard diameter stock bars. The most economical bar size for machining the shaft shown in fig. 13 would be 1¼, which is a standard stock size.

(To be continued)



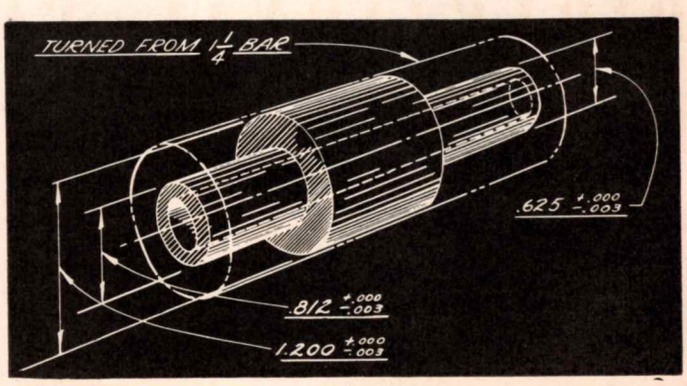
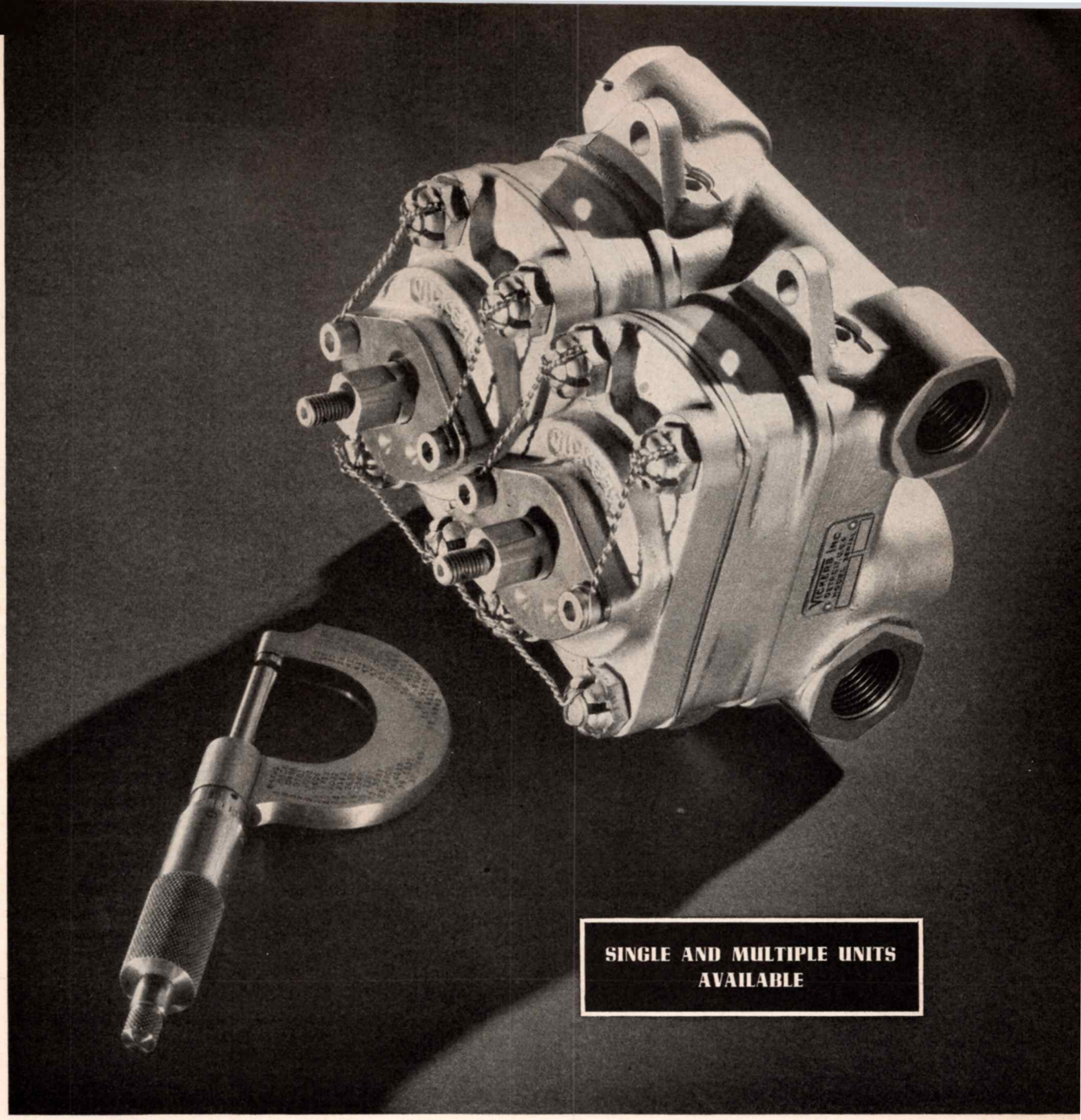


Fig. 12: (left) Recessed-bored holes, difficult to machine
Fig. 13: (above) Design parts for turning from standard stock



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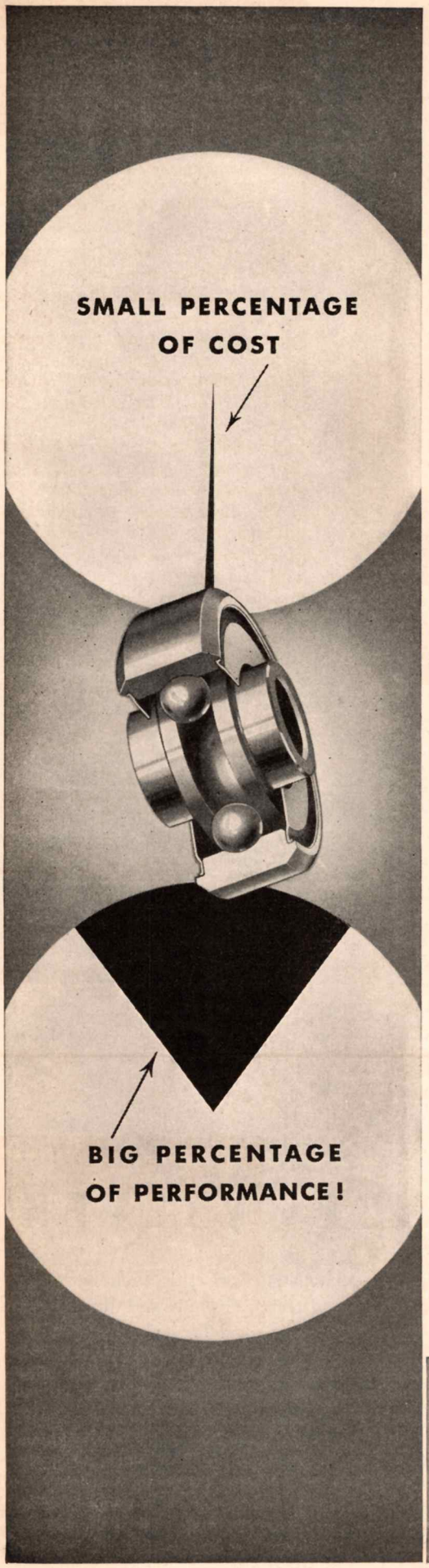

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That is why Fafnir developed special plating, installed automatic greasing equipment that measures pre-lubrication to the fraction of a gram. That is why Fafnir makes more than one hundred inspections of Fafnir Aircraft Ball Bearings, with six basic, key inspections of *every bearing that we ship.*

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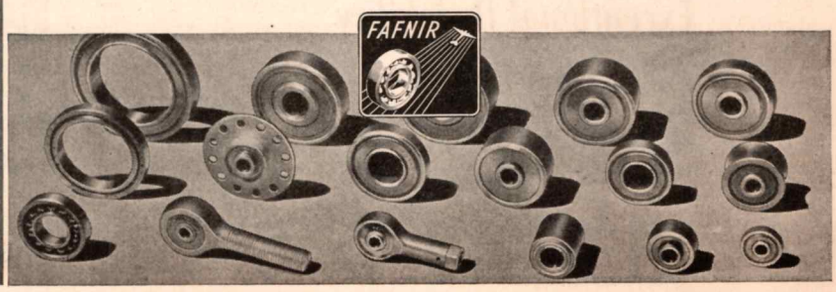
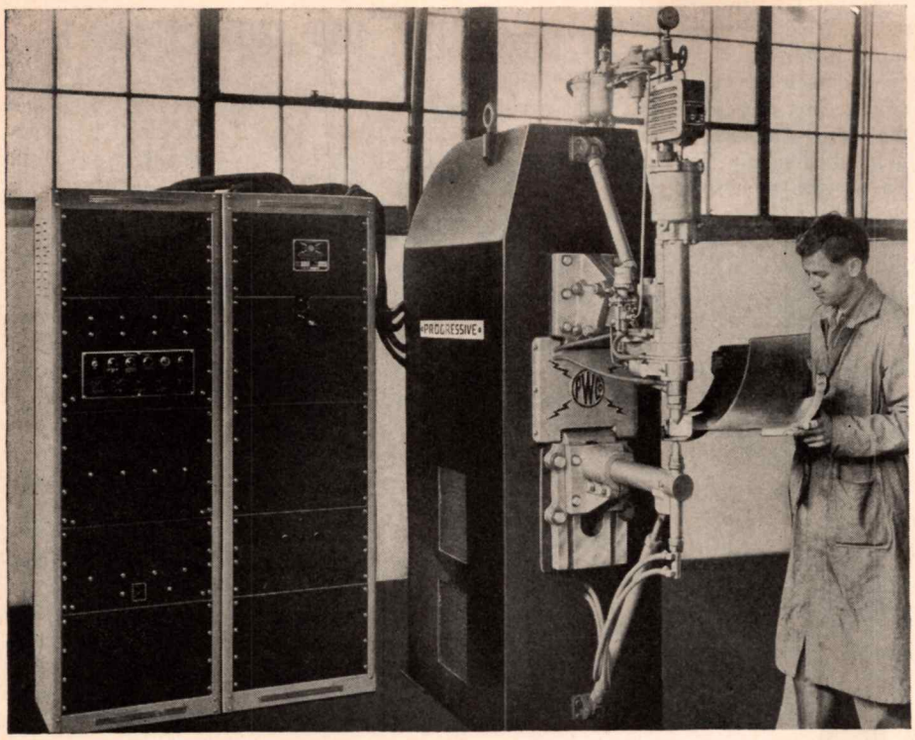




HIGH SPEED PRODUCTION SPOT WELDING OF ALUMINUM ALLOY

● The speedup to mass produce quantities of military aircraft has created a demand for high output machines which normally would not have become available until some time in the future. Thus, by fostering advanced and improved techniques in aircraft construction, the industry has again helped the entire American industrial picture—an occurrence which is taking place with greater frequency as aircraft production in this country approaches new records.

Among the paramount problems originally encountered in the defense program was that of high speed production welding of aluminum alloy sheet, but this has been met, in part, by a new spot welder developed by Progressive Welder Co., of Detroit. Involving an entirely new principle of operation, the process is said to produce welds in aluminum alloy with a uniformity equal to that possible in production-welding of steel.

Capable of producing its welds beyond the strength required by government specifications, the process involves neither costly, nor complicated "energy accumulators," nor special skill on the part of the operator. Welding speeds are directly in line with those customary in the welding of sheet steel and are limited largely only by the speeds at which the work can be moved between welds.

In addition to showing a striking uniformity, the welds are apparently free from cracks and blow holes. The actual operation of the machine is exceedingly simple, requiring only two adjustments to take care of all conceivable types of welding operations within its capacity.

The principle on which the equipment operates is based on the use of all 3 phases of 3-phase alternating current, the proper wave form for the weld being developed in such a manner as to permit accuracy of control of welding current. The flexibility of equipment permits the welding of aluminum sections totaling ¼" in thickness down to the thinnest weldable sheet on the same machine. It is possible, for instance, to spot weld 7 pieces of 0.032" section 24 ST sheet with a 150 kva 3-phase welder.

Shear-strength tests made on 50 samples selected out of 100 run under operating conditions which simulate actual shop conditions show a better than 100% margin over government requirements. They show weld strength variations to be not over 5% from average.

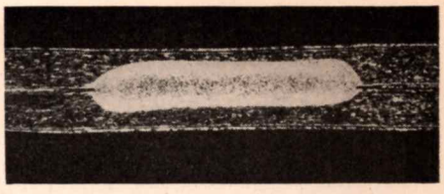
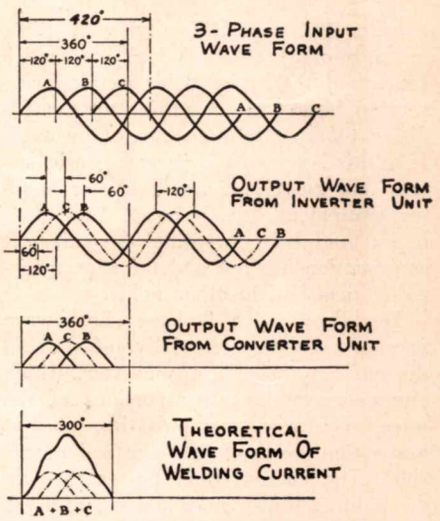
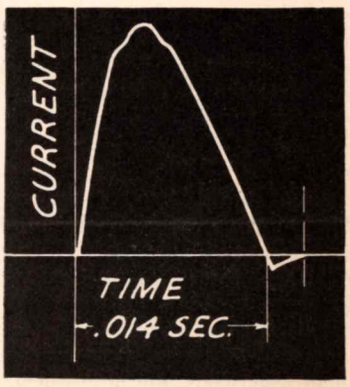


Photo-micrograph of typical specimen weld showing satisfactory grain structure free from cracks, blow-holes, etc.

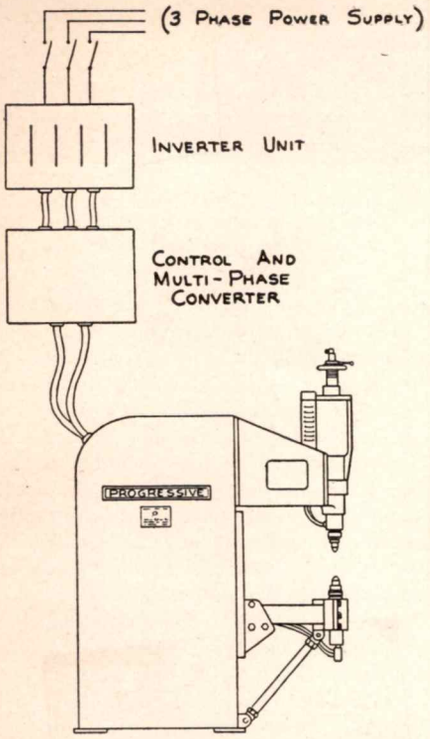
The welding of aluminum is at best somewhat difficult. It has little resistance to the passage of current and thus requires a large amount of current to obtain a weld. Since its plastic range is so extremely short, the current must be "on" for an extremely short interval. Welding pressure must be accurately controlled and carefully balanced with the amount of current applied to avoid excessive surface indentation.

Of the various complications, the problem of supplying sufficient current to the work is possibly the most serious and has been approached in the past in several ways, among them being the use of: capacitor banks; motor generator sets; the charging of a capacitor bank by direct current followed by discharge through the primary circuit of a welding





Best welding current wave for aluminum alloy sheet is steep-walled with "sustained" rather than sharply peaked form during the weld. The drawing above is from an oscillograph recording made during an actual weld



Schematic diagram indicating how 3-phase alternating current is converted to produce sufficient current for welding aluminum without complicated or costly equipment

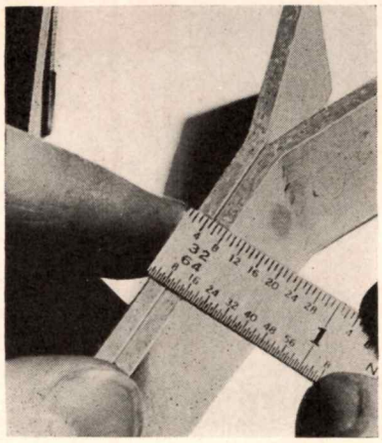
transformer, *etc.* Difficulty with these methods of approach is lack of positive control of the "output" or welding current so necessary for uniformity, in addition to the mechanical costs involved. If to this is added the slowness in operation and complications of earlier welding equipment, *etc.*, it is not difficult to understand why welding for aircraft construction has not had the same progress it has had in other fields.

The Progressive 3-phase short wave process consists, essentially, of passing the current through a converter, which eliminates the negative portions of the wave. The resulting pulsating current has a time cycle of 300° instead of the 360°. The current then passes through the welding transformer and is amplified. The resulting secondary current wave form is ideal for the welding of aluminum. The current rises to its maximum almost instantly, stays at this value for practically the entire duration of the weld, then drops to zero in an extremely short period.

A timer panel for the various sequences of the welding operation which also houses the ignitron tubes, provides completely automatic operation for an unusually wide range of aluminum welding operations. With it weld time can range from the maximum (1/2 sec.), down to zero. Thus, the adjustment provides for correct welding time for any conceivable aluminum spot welding job.

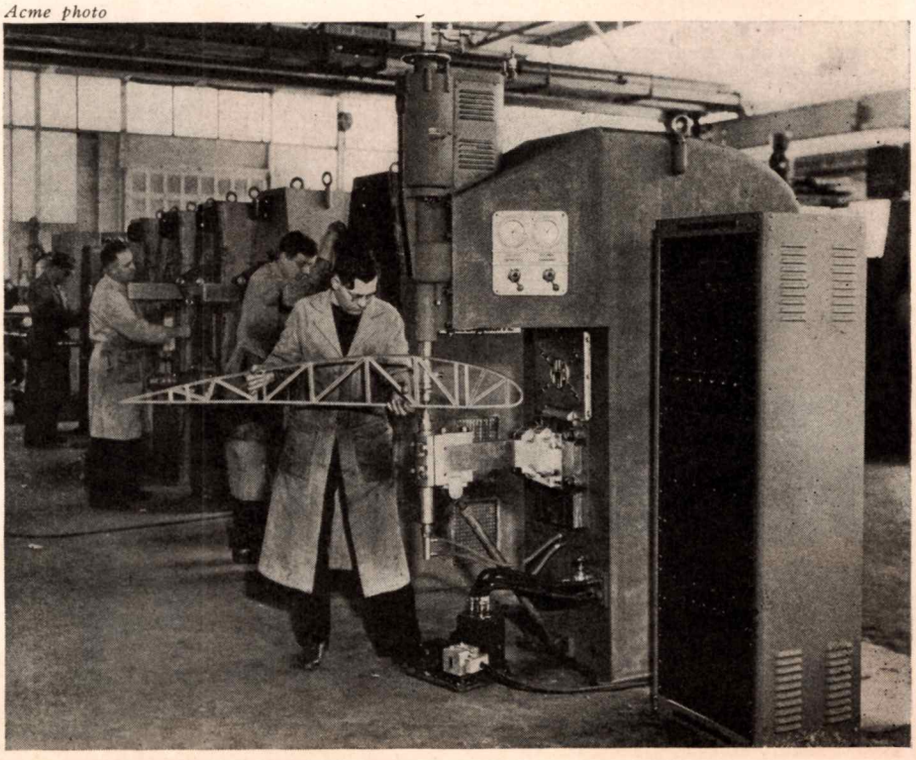
The complete equipment, mechanically, is almost identical with standard Progressive pedestal-type welding equipment. Welding pressures are obtained through a standard Progressive direct air-operated pressure cylinder which is mounted on the upper arm and actuates the upper welding electrode, and are so handled as to provide a follow-through. To provide a closer and more positive connection between welding transformer and work, an air-operated secondary shunt clamp grips the upper electrode after the work is under welding pressure.

Automatic repeat timing, which allows sufficient interval between welds to re-position the work, permits making any number of welds in succession automatically without re-closing the pilot device for each weld.



Two pieces of 1/8 inch 24 ST aluminum welded by the same machine which can also handle .032 inch material. The view below shows a workman checking the first production model of the new Progressive Welder Company's three-phase short-wave aluminum welder

Acme photo

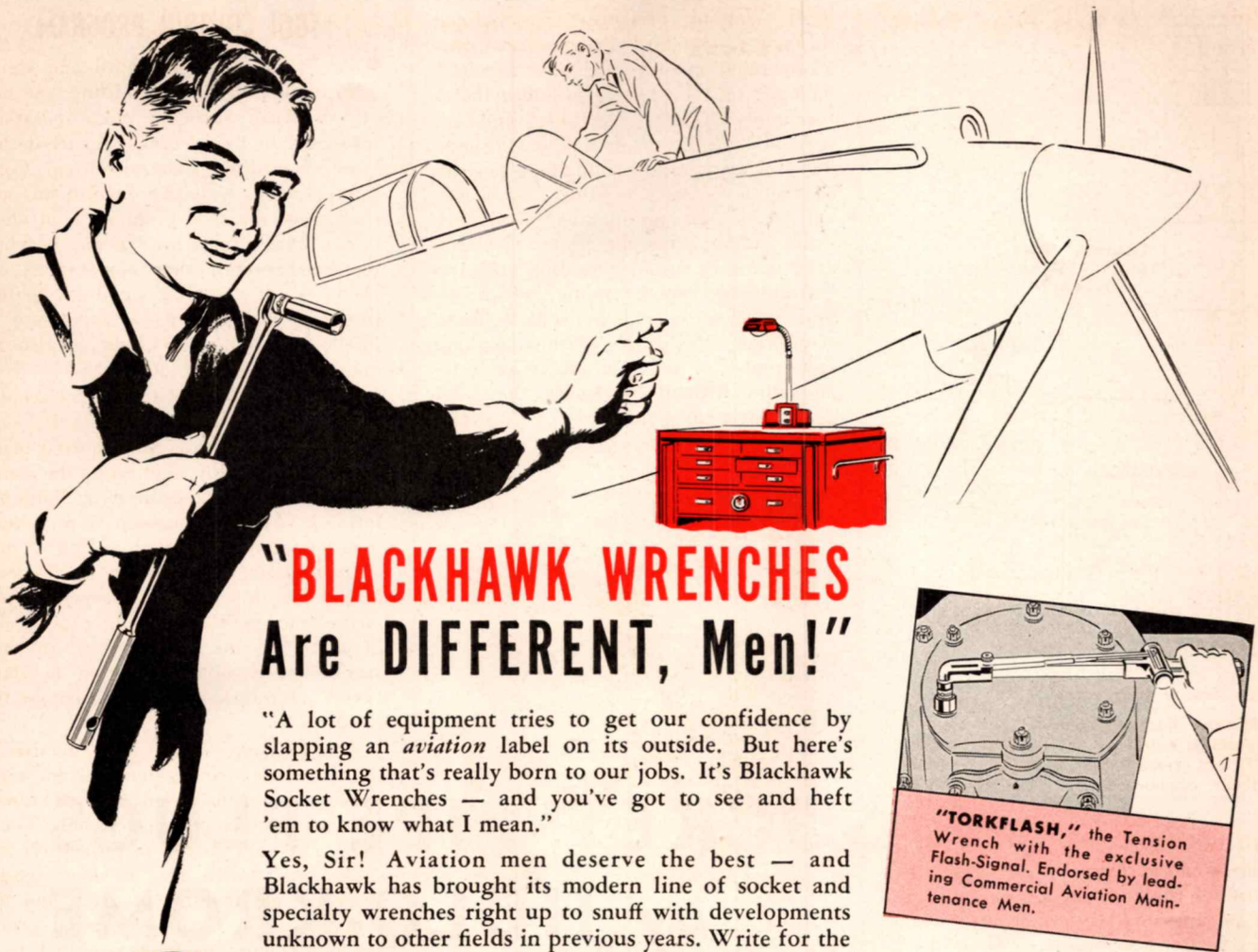


TOOL CONTROL PROGRAM

● An ingenious tool control and standardization program permitting the use of "standard" tools for most operations involving the use of tungsten carbide has been evolved by Federal Mogul Corp. The results of extensive experiments and shop tests, the new program is in effect in the plant where bushings and bearings for engines and other applications are produced. It not only simplifies tooling problems and permits a wider use of tungsten carbide tools, but it also reduces tool costs and stocks.

Fundamentally, standard Carboloy tools are used almost exclusively, such special tool shapes as are required being obtained largely by re-grinding the standard tools to the shapes desired. Similarly, forming tools are built up from a combination of standard tools, using a form of tool holder developed by Federal Mogul for this purpose. Previously, cemented carbide tools were largely special in character, the cost involved in such specialized designs mitigating to some extent against their wider usage in the plant.

Another factor previously effective in limiting the extent to which carbide tools were used was the absence of specialized grinding equipment for such tools. These were sent back to the manufacturer for sharpening under the previous set-up. With the new control program and the wider usage of Carboloy, special grinding equipment has been installed in a centralized grinding department, and operated by specially trained operators. Special built-up tool holders were developed by Federal Mogul to assemble the form tool units from standard tools.



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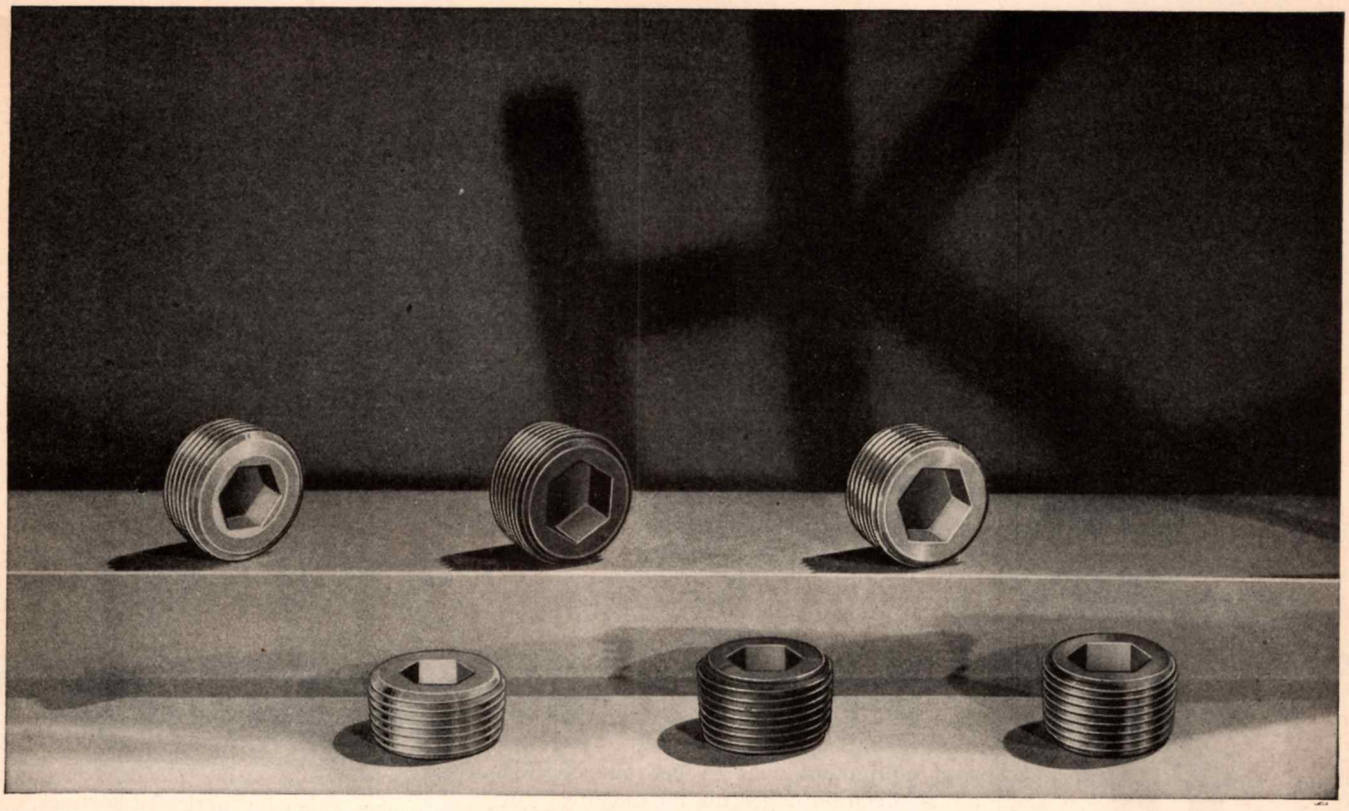

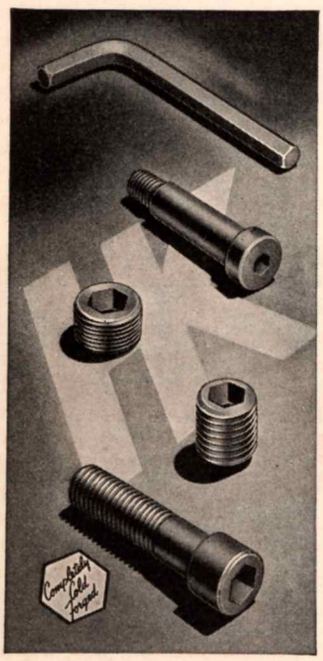

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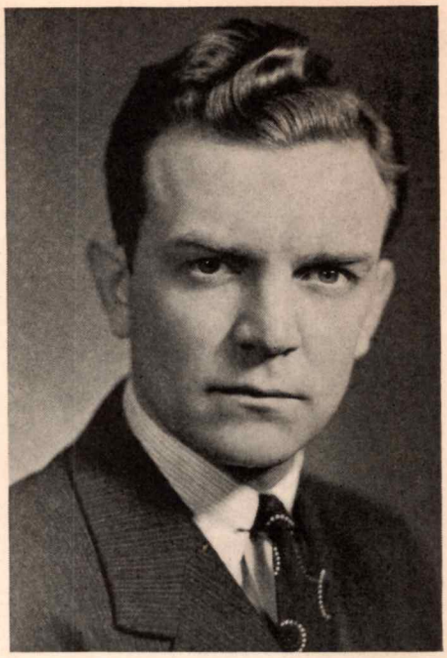


● The aircraft industry, perhaps more than any other, has done more towards making engineers and production men conscious of the necessity for finer surface finishes and of the importance of better finishes for metallic surfaces.

Back in 1934, when the Chrysler Corp. were having trouble with wheel bearings brinelling in the shipment of automobiles by rail and truck from Detroit to the West Coast, it began learning the full importance of having finer metallic surface finishes for bearings. The minute roughness or polishing marks that were left on the wheel bearing races would become indented by the hardened steel rollers such as are found in the familiar taper roller bearings.

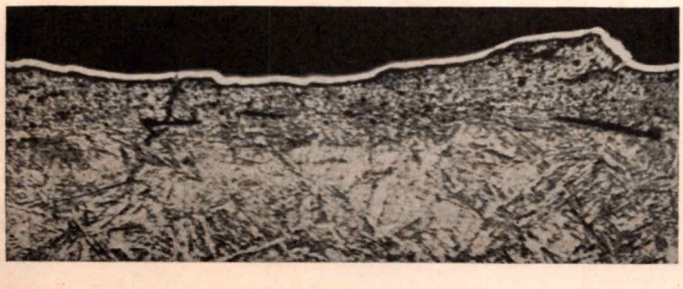
D. A. Wallace, president of the Chrysler Division of the Chrysler Corp., and a thorough mechanic as well as an executive, realized that when this roughness was removed, this indenting of the races or what is commonly known as "Brinelling," could also be eliminated. This brinelling condition has been found in aircraft wheel bearings, the condition resulting from vibration of the airplane in flight where there is no rotation of the wheels. This would cause the races of the wheel bearings to become indented to the depth of the polishing marks and failure occurred. Not only was this condition found in the wheels, but also in the rocker arm bearings where there is no complete rotation.

Going back to Chrysler's problem, it was found necessary to remove the tool marks on the bearing surfaces and exposing as the bearing the true crystals of the metal in an undisturbed condition and with the bearings geometrically developed to the correct dimension. These marks or what we now refer to as fragmented and amorphous material, could be removed to expose as the bearing surface the true crystals of the metal, by using a bonded abrasive under extremely light pressures and slow abrasive movement in surface ft./min., with multimotion or what could be called a scrubbing action and in the presence of a lubricant of the proper viscosity. This eliminated the bearing brinelling conditions, and since it proved so satisfactory, Chrysler applied the Superfinishing technique to all other moving bearing surfaces in its automobiles. Today, Superfinish is being widely used by every industry producing metal bearing surfaces, either for lubricated bearings, nonlubricated bearings, or static bearings.

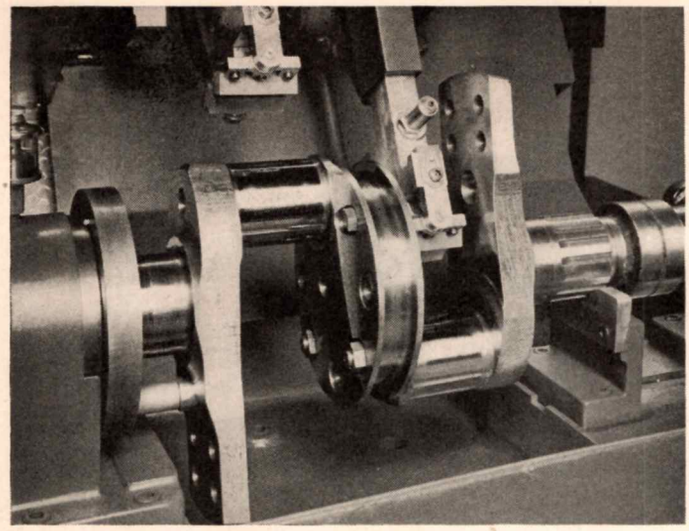
Since the inception of Superfinish it has been found that comparatively few people are qualified to describe a good bearing surface. Along with the development of Superfinish there have been developed a few instruments for measuring surface roughness, but none of these will measure surface quality. It has only been in the past few years that surface finishes have come to the attention of engineers and production men to the extent that they have really tried to do something about it.

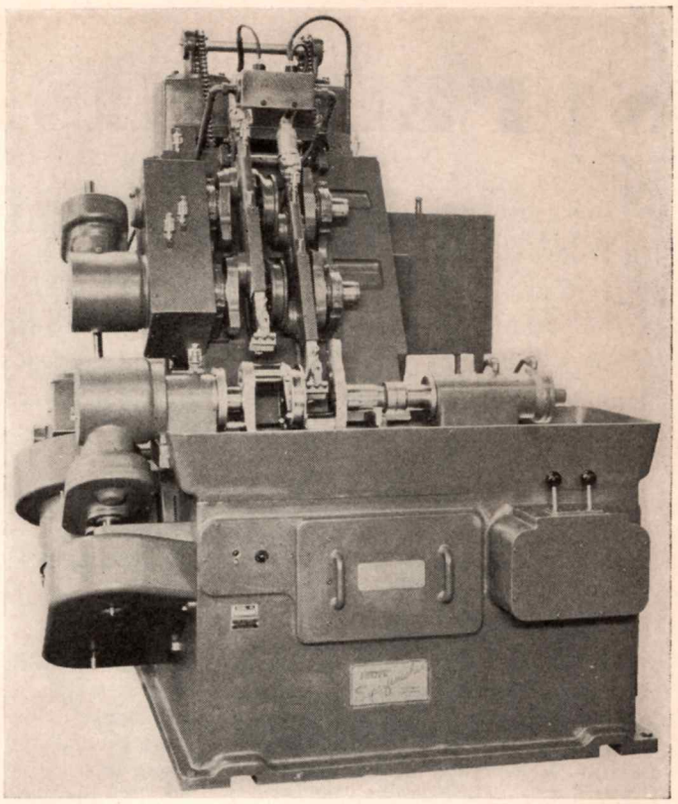
To determine the quality of the surface we must know more than available instruments tell us. We need to know more than the microinch reading of the roughness of the surface; we must know the quality of that surface as a bearing. We must not only measure the roughness of the surface but also the chatter marks or inaccuracy of dimension. We must

The profile photomicrograph below, taken at a magnification of 250 diameters, is of a turned surface. A difference in metallurgical structure will be noted between the outer surface and the body of the part. It is this outer surface of the bearing that has been deformed and metallurgically changed due to the pressure and resulting heat of the machining operation and is that which is almost immediately worn off in use, causing improper clearances which result in failure



This profile photomicrograph, magnified 250 diameters, is of a ground surface and distinctly shows the metallurgical change in the structure at the outer surface. Here it can be noted is a portion of the outer layer ready to be flaked or broken off. This picture shows what is meant by a metallurgically defective bearing surface. The process of Superfinish removes this outer defective surface layer and exposes the underlying undisturbed crystals in a geometric plane





A Superfinishing machine for airplane engine crankshafts. Equipment for doing this operation is being quite generally used throughout the aircraft industry today for producing surfaces that are smooth and metallurgically free of fragmented and smear material. The close-up view (above) shows the broad Superfinish stones just after they have completed contact with the bearing surface. It can be seen that there are no scratches around the bearing surface but that they are scrubbed free of peaks and projections

also determine and correct the metallurgical changes caused by the dimensional machining operations in the metal structure at the surface.

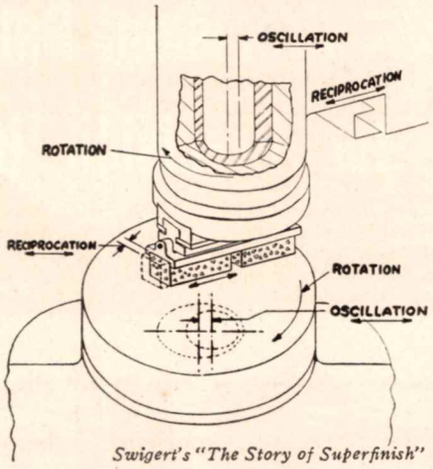
Dimensional Machining and Grinding

In producing a bearing surface, the metal is subjected to a series of machining operations before it is finished. The part may first be either forged or cast into shape and then machined, first in a roughing operation on a lathe with a point of a tool. It may get both a rough turning operation and a finish turning operation, both operations using the point of a tool as the cutter. The extreme pressures and the high speeds commonly used in such machining operations generally create temperatures well above 2000° F. between the tool and work so that the material of the bearing is physically and chemically changed at the surface. This change is of such magnitude that there results an entirely different material at the outer surface than was specified by the metallurgists and engineers who designed the unit.

Tool engineers and production men have for years concentrated their efforts towards producing better tools, so that we might have faster rates of production. Metallurgists and research men have concentrated their efforts towards producing better steels so that we might have a better product, but in the rush for faster production and higher quality products, it seems they neglected to heed what took place at the surface during the machining operations.

Better tool steels allowed faster speeds which necessarily created higher working temperatures and thereby created an entirely new problem—bearing surface metallurgy. The same is true of abrasive grinding operations.

The next step of refinement would be grinding. This operation generally employs extreme pressures and speeds which create temperatures that also cause physical and chemical changes in the metal at the surface. Thus, we are still using another material than that which the engineers and designers specified as the bearing surface. The grinding operation, when a free cutting



Swigert's "The Story of Superfinish"

This sketch graphically portrays what is meant by multimotion. Here we see the stones in operation and the equipment showing the many motions that are incorporated to generate the geometrical accuracy into the part being worked. These motions are applied not only to flat work (as shown in the sketch) but also to internal or external cylindrical work

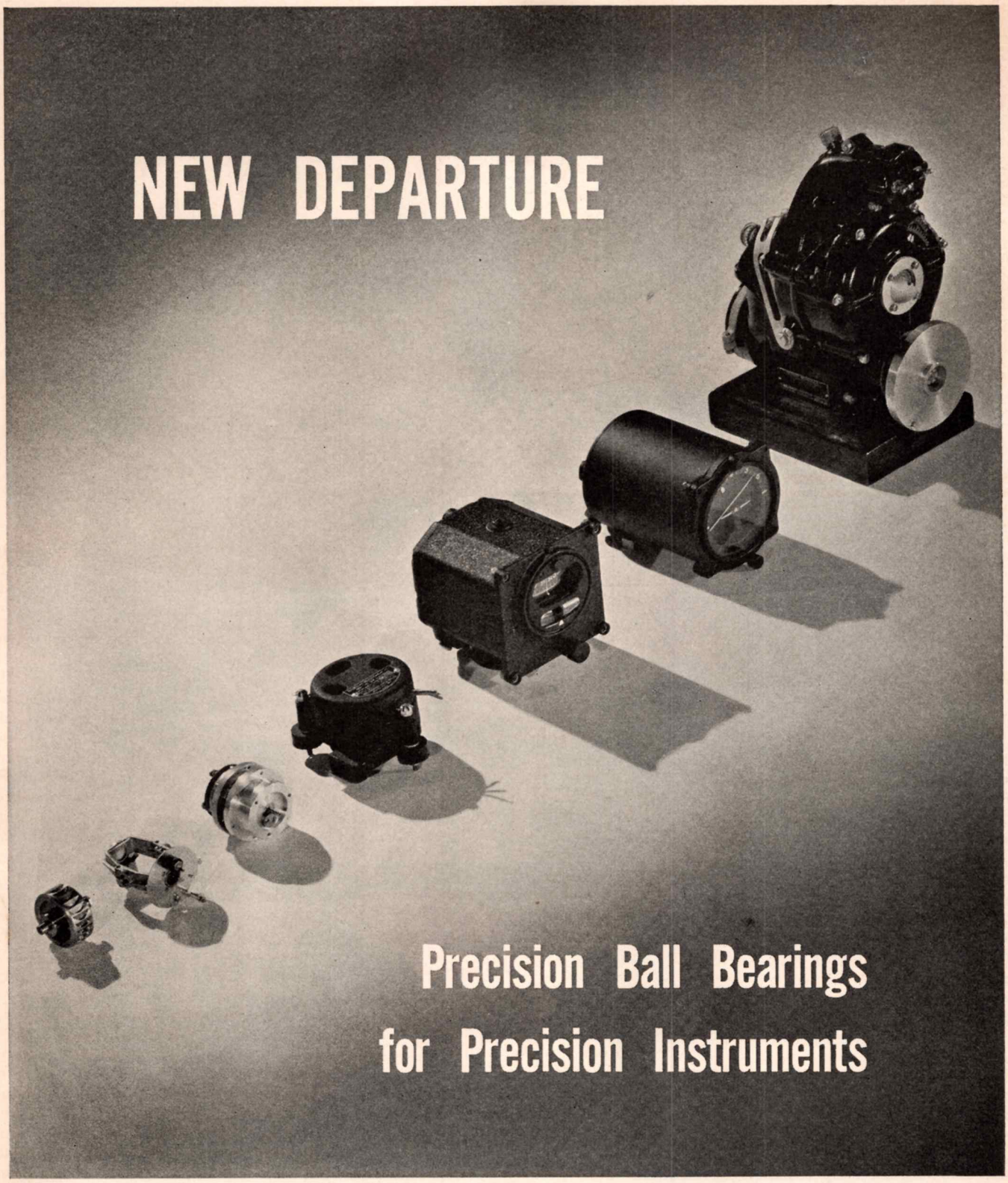
wheel is used, will abrade the metal cleanly and leave a surface which is too rough to be used as a bearing. To overcome this, there has been advocated in recent years, the use of fine grain abrasive wheels which do not possess free cutting qualities but which produce a smoother, but smear metal surface. By using such a wheel under great pressures and speeds, enough heat is created to cause the metal to flow and smear over the underlying surface, giving a high luster. Even though this smear metal is spread over and adheres to the body of the bearing, it is of an *entirely different microstructure than the underlying basic material*, and in use and under load, it will flake off causing scuffing, scouring, and seizure.

With the aid of Superfinishing operations, where no heat is created because of extremely low pressures, slow abrasive speeds and multimotions, the layer of tool marks and metal that is metallurgically different from the body of the metal is removed, exposing the true crystals of the bulk metal as the bearing surface in an undisturbed condition.

Burnishing and Honing

Burnishing operations produce smear metal in somewhat the same manner as grinding except that there is no abrasive in the roller. Burnishing operations are intended to produce smoother surfaces by forcing over or crushing down the peaks into the valleys and making a smooth surface. In order to force the metal into the valleys, heat

(Continued on following page)



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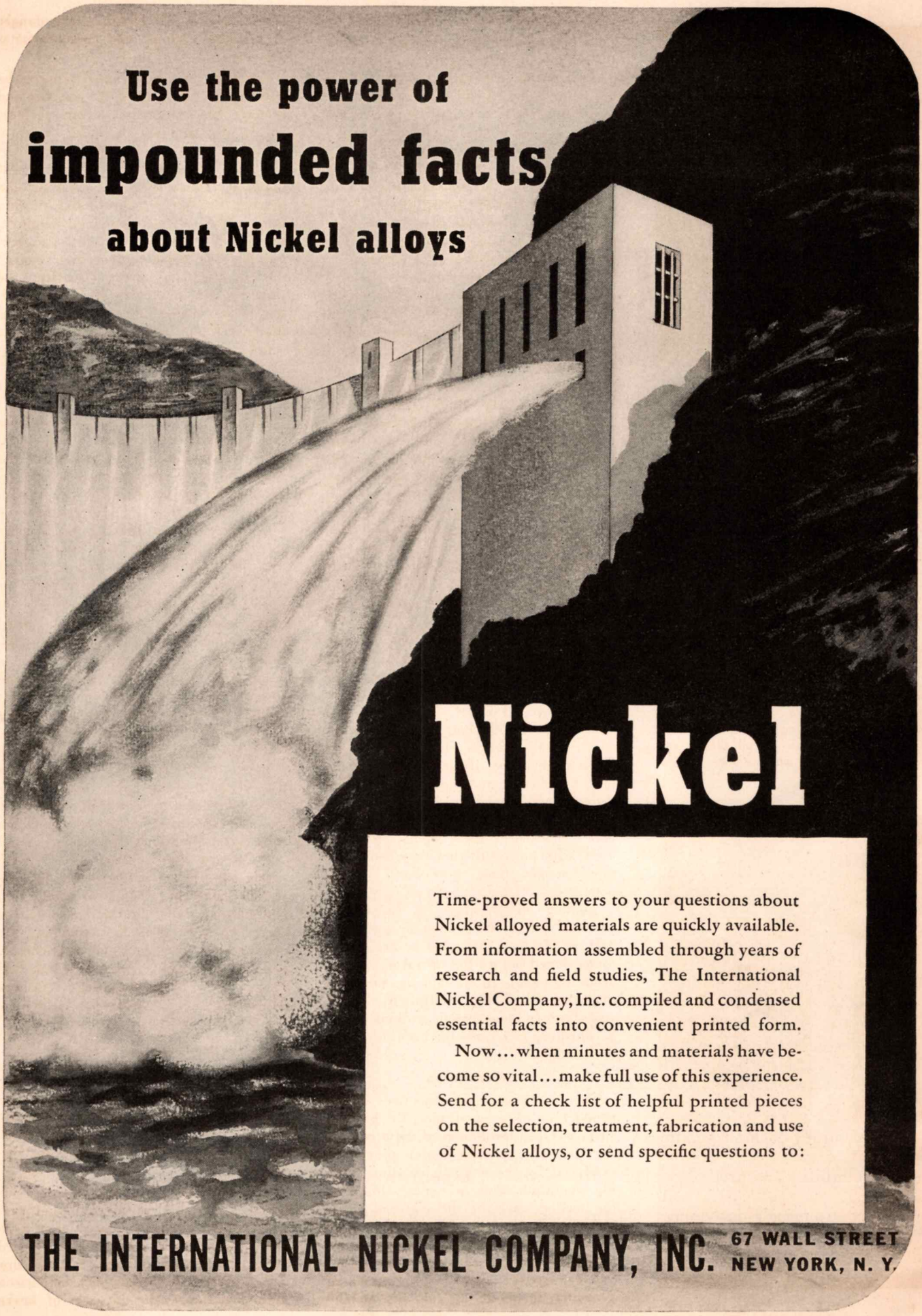

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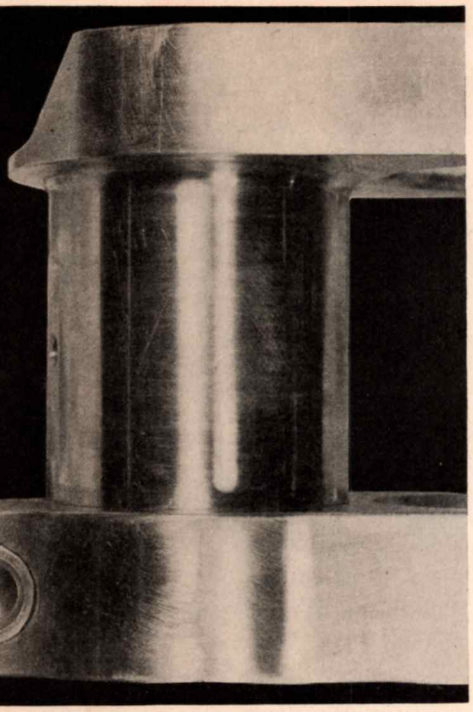
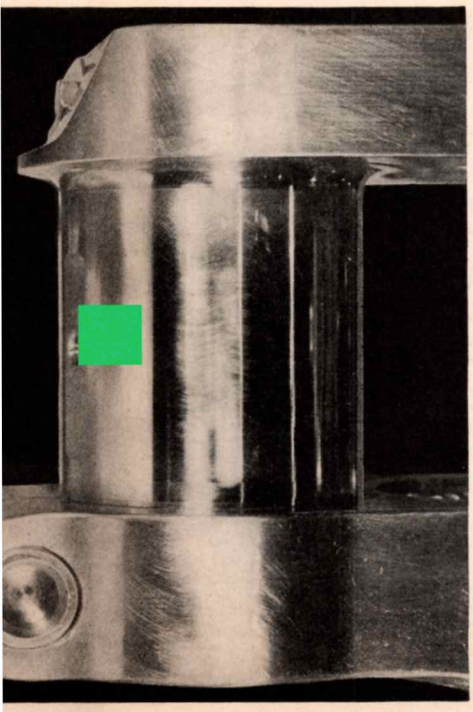


Close-up view of a crankshaft bearing which has been polished in the conventional manner and measured approximately 5 to 10 microinches, showing scratches around the bearing surface; these are peaks or projections above the surface that will puncture oil film and cause metal-to-metal contact with resulting wear. The view below is of the same type bearing after it has been Superfinished to one microinch. There are now no peaks or projections on the bearing surface to rupture an oil film, thus allowing perfect lubrication with a much thinner film of oil than a surface finished in the conventional manner



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must be produced at the surface to cause the metal to flow. Again the physical and chemical properties of the metal are being changed and it actually smears over the surface in much the same manner as it does in the grinding operation where the fine abrasive wheels are used under great speeds and pressures.

The influence of Superfinish has had a far-reaching effect during the past few years, in that there has been a noticeable change in honing operations particularly, in that an endeavor is being made to get lower pressure, slower speeds, and short multi-random motions. However, to produce the finest possible finish and the greatest accuracy, abrasive stones should be as long as the work-piece, where this is possible.

Another method of producing fine surfaces has been hand lapping, used particularly for plug gauges. In normal times gauge makers could meet industry's demands, but under the pressure of the defense program they have been obliged to use a high speed method which produces gauges to the desired accuracy. Superfinishing has met their needs, for they have not only been able to increase their production rate, but their gauges are longer lived. This is especially true where gauges are rebuilt with chromium which frequently has hard and soft spots in a single piece. In lapping rebuilt chromium plug gauges in which there may be soft and hard spots, these will be equally dimensioned and finished. However, in use, the soft spots will wear out comparatively quickly and ruin the gauge. One advantage of Superfinish is that if there are soft spots in the chromium, the Superfinishing stones detect these immediately and show them up dimensionally. Consequently, only gauges of a constant hardness are used, with the result that they last many times longer than most hand lapped gauges.

Another disadvantage of lapping a bearing is that there must be a mating half, or lap, and this must be accurately dimensioned before the operation so that accuracy can be built into the part. On the other hand, the multiplicity of the simultaneous-in-movement motions of Superfinishing generates the accuracy upon the surface.

Superfinishing

There are two main objectives in the production of a good metallic bearing surface. One, *Metallurgical*, is to remove the defective surface metal previously produced by the shaping or dimensioning operation, and to expose, bisected, the true crystals of the material so as to leave an extremely fine plane surface. The other objective, *Geometrical*, is to remove the hills and valleys (scratches and/or flaws); and by the laws of geometry, generate a true and smooth surface which will eliminate the danger of oil film rupture and metal-to-metal contact.

Not only does Superfinish remove the metallurgical defects of the surface and produce an extremely smooth surface, but it also removes the peaks or projections above the bearing surface leaving few, if any, valleys among flat plateaus. There are no peaks on the bearing surface to rupture the oil film and allow a metal-to-metal contact. Peaks will rupture the oil film and permit metal-to-metal contact even though the oil used has great viscosity; the churning action created by the projecting peaks causes internal friction and thins the oil so that the peaks will break through and contact each other.

Helps Defense Program

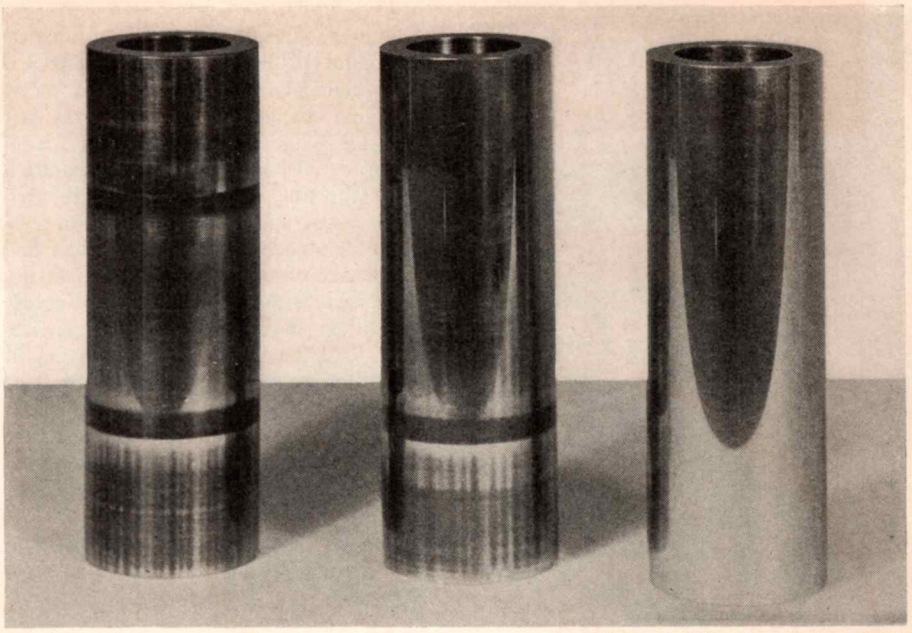
The defense program has brought into use considerable equipment which otherwise would have lain idle. This old equipment may not be capable of producing the accuracy which is needed, and if it is to be used there must be some means of correcting inaccuracies as well as producing the finest finish. Superfinishing is being used to correct inaccuracy of machining operations.

The broad Superfinishing stones which bridge most of the inaccuracies caused by grinding or turning when Superfinishing employing a multimotion or scrubbing action under *high* pressures and speeds, will produce the accuracy needed. Final finish is obtained by decreasing the pressures and speeds and using the Superfinishing technique which removes the roughness and exposes the true crystals of the metal as the wearing surface of a geometrically true bearing. The combined results of producing more accurate dimensional bearings as well as smoother surfaces is of inestimable value when it is realized that we will be using for a number of years, old equipment without sacrificing results or cost. Not only does the technique develop accuracy of dimension and smoothness, but increases tensile strength and fatigue life by eliminating scratches which might be the basis for failure.

Non-Lubricated Bearings

Smoother and geometrically truer surfaces have been found to be advantageous not only in lubricated bearing surfaces, but also in dry moving bearing surfaces and in static bearing surfaces.

Consider first the dry bearing surfaces. Before the advent of Superfinish brake drums, brake lining, clutch pressure plates, *etc.*, were either turned or ground as a final finish. Usually this was a costly operation by comparison with Superfinish. In the case of brake



This unretouched photograph shows three aircraft engine piston pins; the one at the left is shown as it was taken from an engine after having been run. It shows shadow flats which were created in the grinding operation. The pin in the center has been Superfinished on the upper end while the pin at the right has been completely Superfinished

drums there was a roughing, semi-finishing and a finish operation in which the drum was finish-turned with a .005 feed on the tool which left a roughness of from 70 to 100 microinches rms. The brake lining was ground with the periphery of a grinding wheel before assembly, then it was assembled to the support and adjusted after assembly of the brake drum and the brake support in the car assembly. Invariably the brakes squeaked or chattered. Today, it is possible to eliminate the finish turning operation and Superfinish directly from the semi-finish operation in 13 secs., producing a surface smoothness of 4 to 8 microinches. The brake lining is no longer ground, but is assembled to the support, adjusted and then Superfinished for 11 secs. This not only eliminates the need for further adjustment, but also squeaking and chattering brake assemblies. It has not only decreased the cost of production and increased the life of the brakes, but also has given much smoother acting brakes.

Static Bearing Surfaces

The importance of Superfinish is evident in the application of static bearing surfaces where maximum heat transfer is important. Superfinishing the seats in cylinder blocks and connecting rods for steel back babbitt crankshaft bearings allows a greater percentage of contact area between the steel back of the babbitt bearing and the bearing seat. Thus, the heat is evenly dissipated or transferred over the entire surface rather than through a few contact points around the bearing.

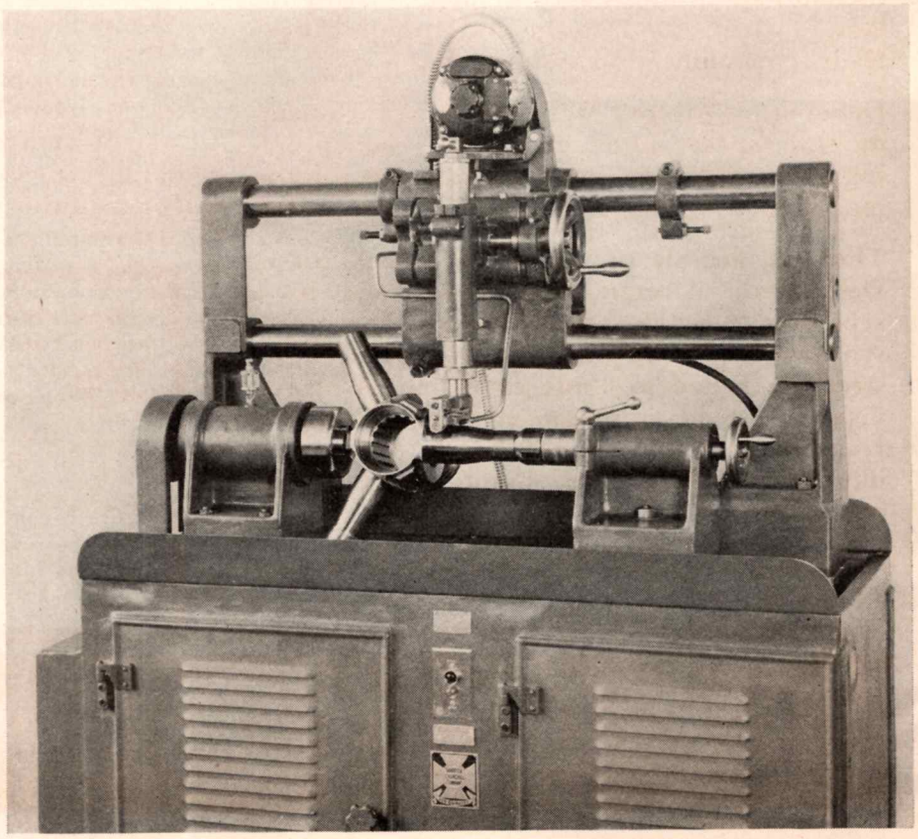
In producing a metal finished surface for maximum load-carrying capacity and wear elimination, the metallurgical condition of the surface is of equal importance to the face condition which is either seen with the naked eye, felt with a fingernail, or measured with available instruments.

Superfinish is a simple procedure, yet because of its simplicity it is difficult to describe. We need only remember that the smoothness of a surface is not the most important factor; it is one of two important factors from the bearing wear and practical use standpoint.

Swigert's "The Story of Superfinish"

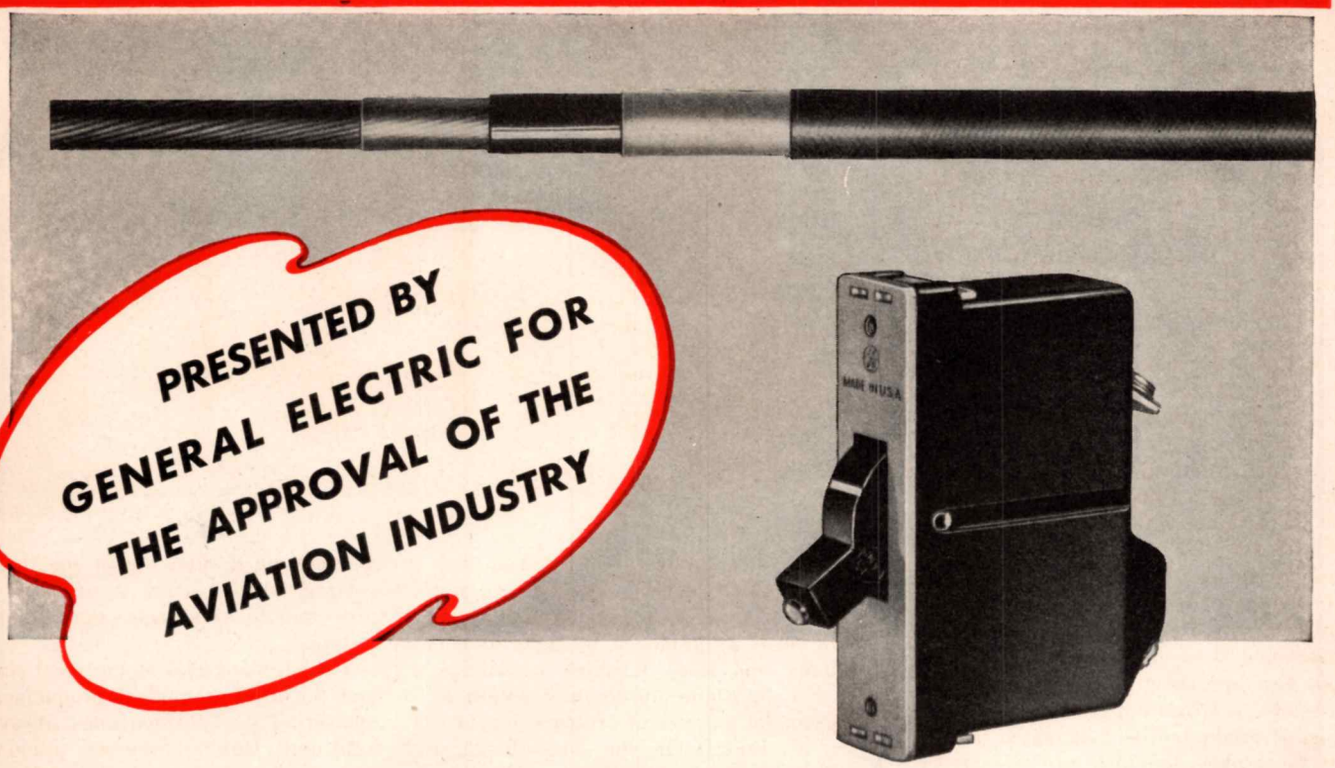
A surface on metallic material may be smooth, measured and checked, but if it is of a different metallurgical structure, such as produced by most dimensioning and some finishing operations, it will not stand up for any length of time under stress and ordinary lubricating conditions. On the other hand, a surface of clean crystalline metallic material with equal smoothness would, even under high stress conditions, give a perfect result compared with a surface having equal smoothness, but which had a fragmented film upon the bearing surface which would disintegrate and give minute clearances that result in failure.

The ultimate goal of the ideal surface and the ideal method of producing and measuring that surface must always be kept high. However, the use, production, and measurement of high quality surfaces, should be practical. Between these there must be a compromise which, if intelligently controlled, will gradually approach the ideal.



Standard production Superfinisher in operation in one of the large aircraft companies. Shown being Superfinished are the bearing surfaces of a three-bladed variable-pitch propeller hub

MODERN WIRING MATERIALS FOR AIRCRAFT



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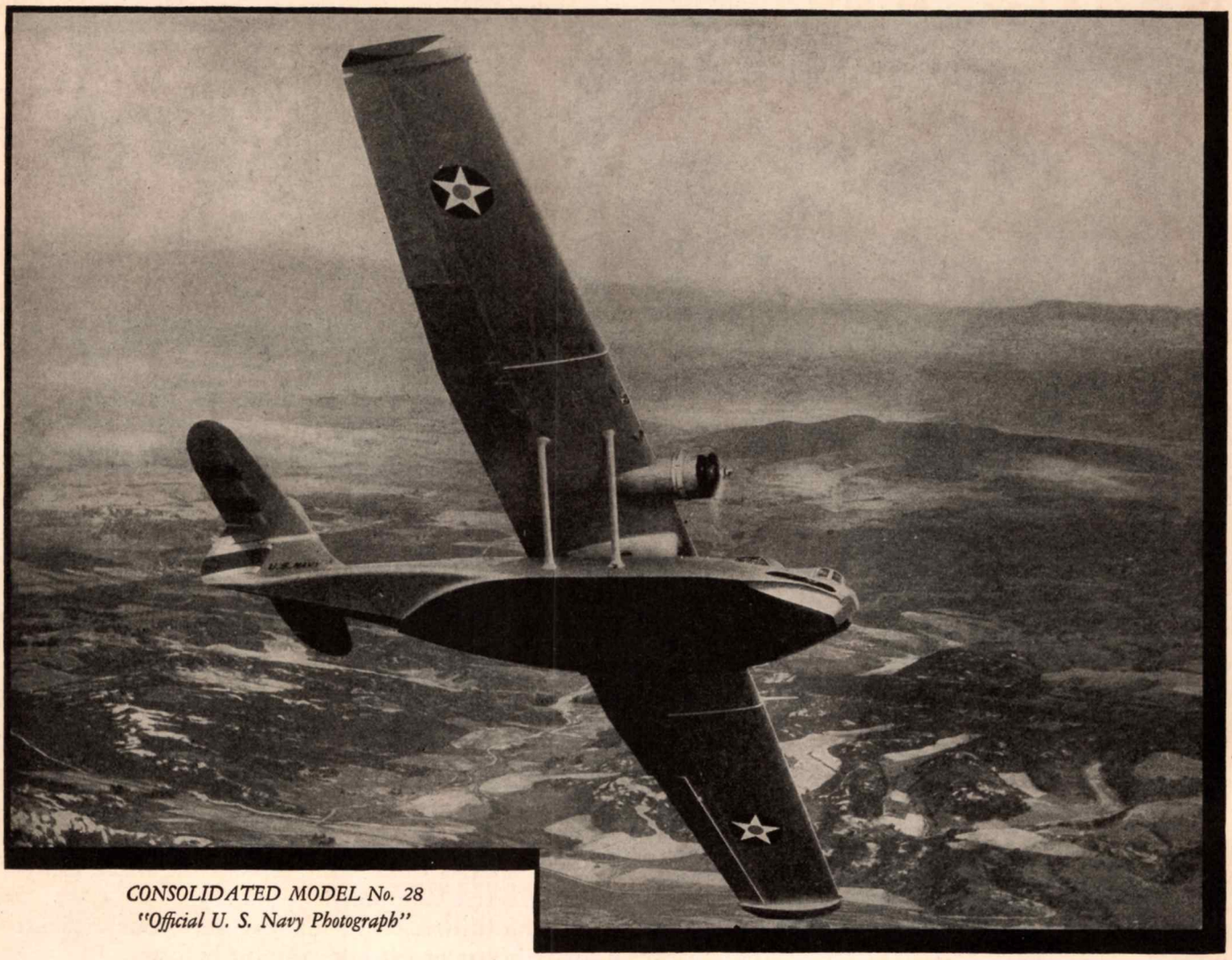

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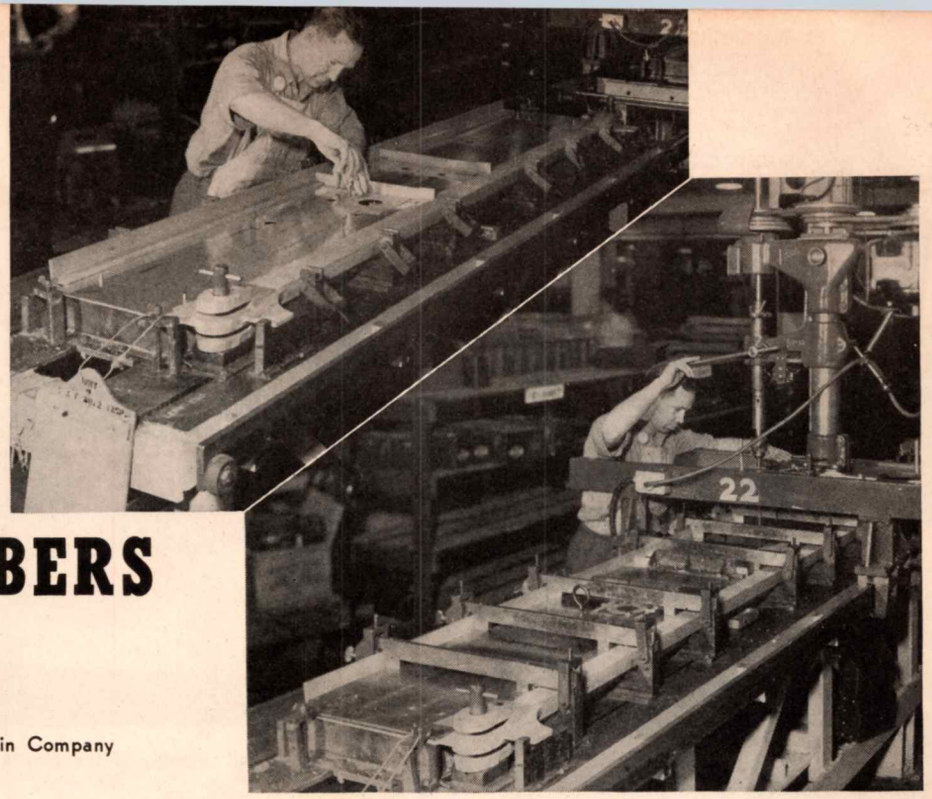
PRODUCTION of MARTIN B-26 MEDIUM BOMBERS

HARRY F. KNIESCHE

Production Engineer, The Glenn L. Martin Company



● When an Air Corps flight test crew from Wright Field boarded the first Martin B-26 medium bomber at the factory in Baltimore around the turn of the year to start official trials of the new type, other airplanes of the same model were pressing against final assembly doors, waiting for official release. There was no prototype; the test ship was a production model. Deliveries would start as soon as the first ship had been approved.

This phenomenal situation stemmed from a tooling and production set-up that looked far beyond the original Army contract which launched the project in Sept. 1939. That contract was for $16,000,000. Normally, such an order would call for a comparatively modest tooling outlay, but the Glenn L. Martin management realized that times had changed. War had flamed in Europe. America must rearm rapidly. The American aircraft industry would be expanded, the demands upon it would be great. The B-26, which had won a design competition, would be needed in quantities.

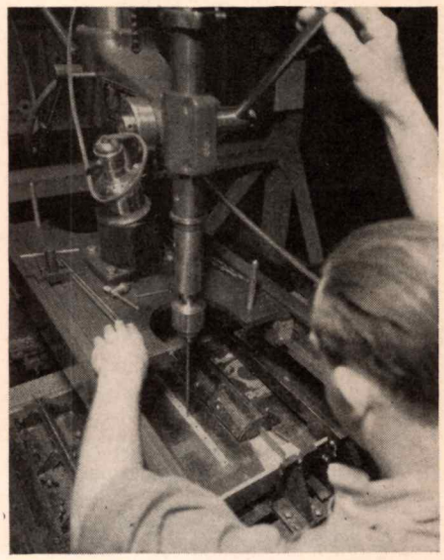
Faced with such certainties, the company evolved an elaborate and much simplified tooling system and planned to produce the B-26 at a rapid rate. And because the tooling was so precise and the model so designed that it was an ideal quantity-production type, it was decided to dispense with the prototype.

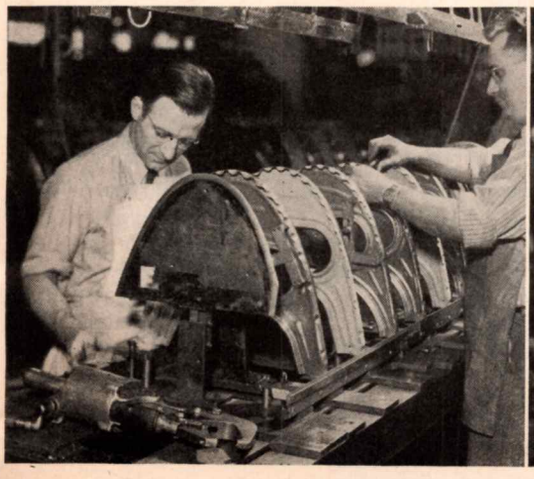
A year later—in Sept., 1940—the expected big orders came through and the backlog for B-26's was raised to around $130,000,000. More of these bombers will be built in a new Government-owned plant to be operated by the Martin company at Omaha, Neb.

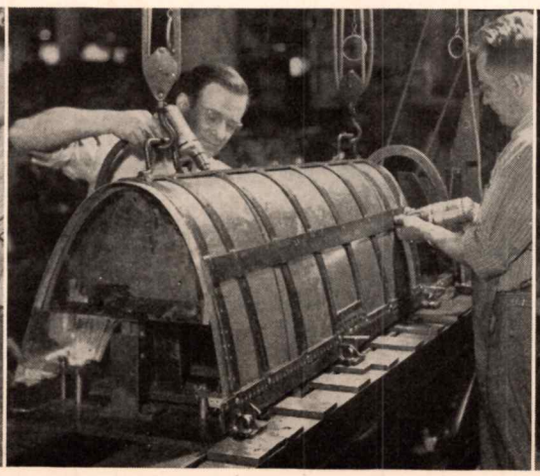
This is the story of how the Martin company met this tooling and production problem.

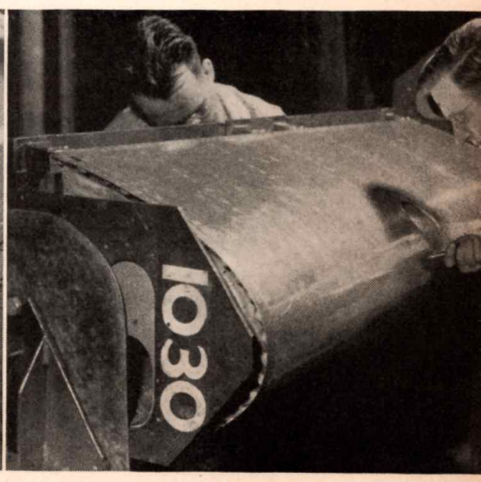
In the first place, it should be realized that so-called "mass production" methods are perfectly understood by the aircraft industry. Having developed its own high-speed technique, it has waited eagerly for the time when aircraft orders would grow beyond the "ten of this, twenty of that, and fifty of the other" stage, with change orders constantly upsetting production.

Assembly of center wing-spar sections. Forging, extrusion and web of sheet metal are laid to fit fixture. Pieces are clamped on and drill pattern laid over assembly. Drill patterns have different colors for each size of hole

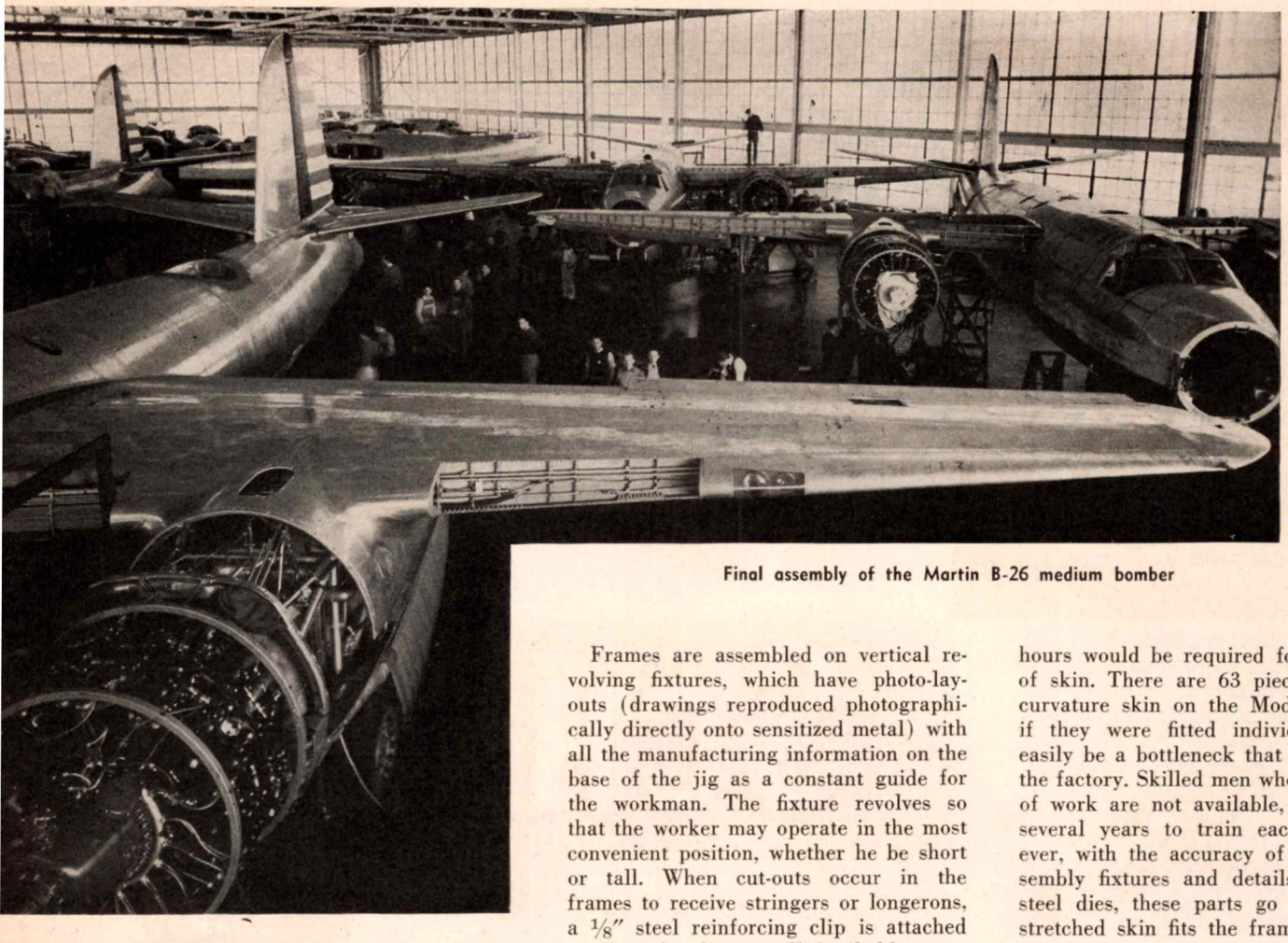








Assembly of leading edge of wing. Ribs are fitted in steel fixture and clamped, formed skin is placed over fixture, and over the whole is lowered metal drill pattern. Assembly is removed from fixture and placed on revolving jig for the riveters



Final assembly of the Martin B-26 medium bomber

When the B-26 won an Army design competition and Martin had decided to take the big step, tool engineers, manufacturing executives, and designers held almost daily conferences to design both parts and sub-assemblies in such a manner that they could be tooled and manufactured both economically and speedily.

Realizing a future dearth of skilled workers when the defense program really opened up, the tool engineers and tool makers were faced with the problem of tooling the job to produce a quality airplane in quantity with a low skill factor.

To do this the airplane was divided into 32 major sub-assemblies or components, which would be delivered to the final assembly floor. These components were then divided into sub-assemblies to feed the production line for each of the components. There are approximately 650 of these minor sub-assemblies which supply the 32 major component parts.

Fuselage frames are made in conventional steel dies in double-crank, straight-side presses, using air cushions in the bed of the press to operate the draw pads. Many of the parts which normally would be welded together and be composed of several pieces, were designed as punchings and made with steel drawing dies. Pilot holes for the skin rivets are drilled in these frames in the flat blank before drawing.

Frames are assembled on vertical revolving fixtures, which have photo-layouts (drawings reproduced photographically directly onto sensitized metal) with all the manufacturing information on the base of the jig as a constant guide for the workman. The fixture revolves so that the worker may operate in the most convenient position, whether he be short or tall. When cut-outs occur in the frames to receive stringers or longerons, a $\frac{1}{8}$" steel reinforcing clip is attached so that the frame will be held to an accurate shape.

Holes for attaching the stringers and longerons are drilled in these jigs. The stringers and longerons are tooled in much the same way, except that they are long fixtures which do not need to revolve. When the frames and stringers are placed in the large steel assembly fixtures, the frames are accurately located by fixed gauges on the jig and clamped. All clamps are chained to the position where they are used, with a piece of 6" long light-weight sash chain.

All the holes for attaching the frames and stringers are so coordinated that the parts are put together in a manner similar to a boy's erector set. In other words, the parts fit together and the holes line up one with the other. This does not seem to be much of a job, until it is understood that each piece of fuselage skin is formed to a double curvature and made on a stretch press in production.

The skins coming off a stretch press are much more alike than the proverbial peas in a pod. If the airframes were not precise duplicates to within a few thousandths of an inch, the preformed skin would not fit all the airframes, and, instead of taking two or three minutes for forming, each piece would have to be fitted to each ship, and by so doing this with a "Yoder" hammer, two or three hours would be required for each piece of skin. There are 63 pieces of double curvature skin on the Model B-26, and if they were fitted individually might easily be a bottleneck that would tie up the factory. Skilled men who do this type of work are not available, and it takes several years to train each one. However, with the accuracy of the steel assembly fixtures and details made from steel dies, these parts go together and stretched skin fits the frame like paper on a wall.

The manufacture of wings to achieve both an accurate airfoil and a high degree of surface smoothness is a problem that reaches back to the accuracy of spars and ribs. Martin worked with one of the large milling machine companies and developed a travelling-head milling machine having a 30-ft. bed and a cutter-head controlled hydraulically and following a cam. Extruded chords thus can be gang-milled rapidly and accurately. After the chords are machined they are placed in the first-operation steel spar fixtures. In these fixtures all stiffeners, webs and other parts to be riveted into one assembly are located on steel gauges and clamped.

The location of all these parts is foolproof; they will only fit in one way—the correct way. A self-locating drill-plate, carrying hardened-steel bushings, is placed on top of the parts ready for drilling. Here there are several hundred holes to be drilled in 8 different sizes. To insure that the operator will not drill a wrong-size hole, all hole-sizes are given colors, and the drill plate is painted with the proper color around each hole. If in the future Martin must use workers still less experienced, then it will dip the drills in the corresponding paint, so that an operator need not bother to know sizes.

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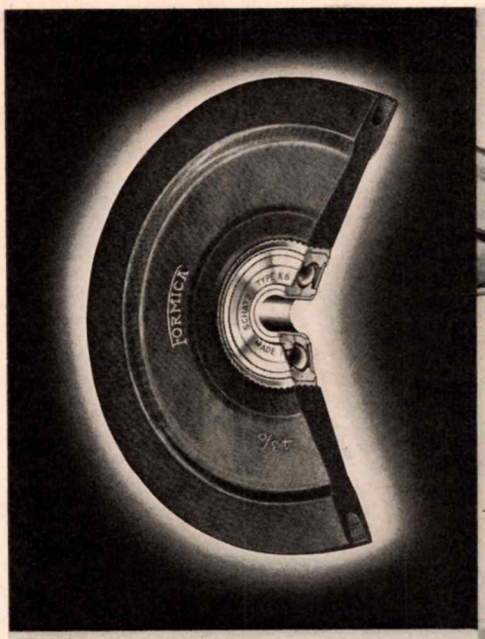

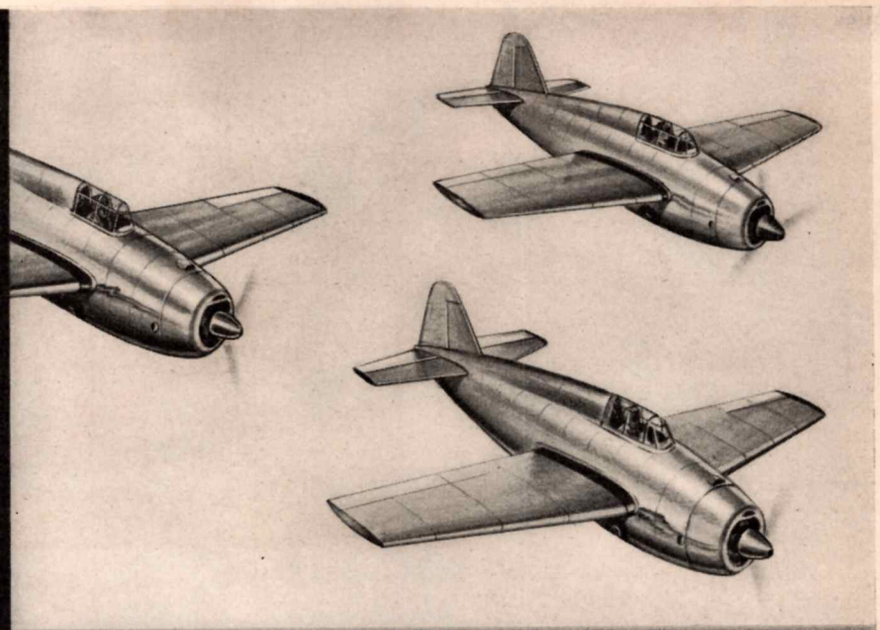

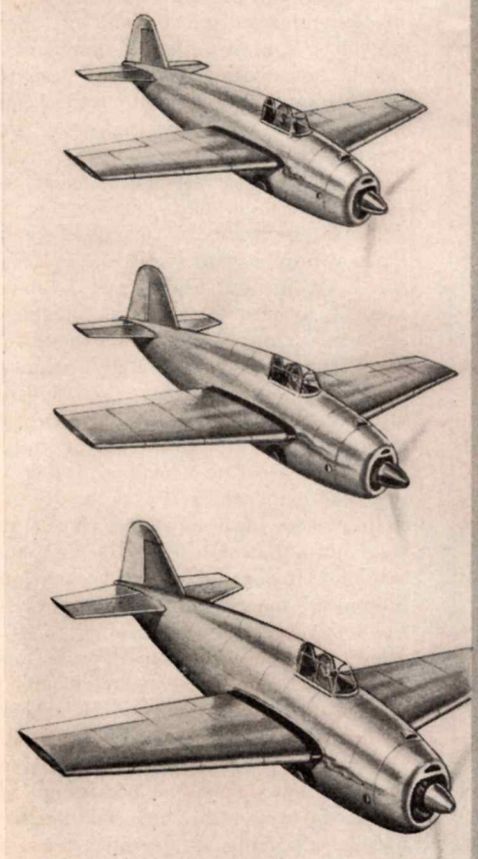

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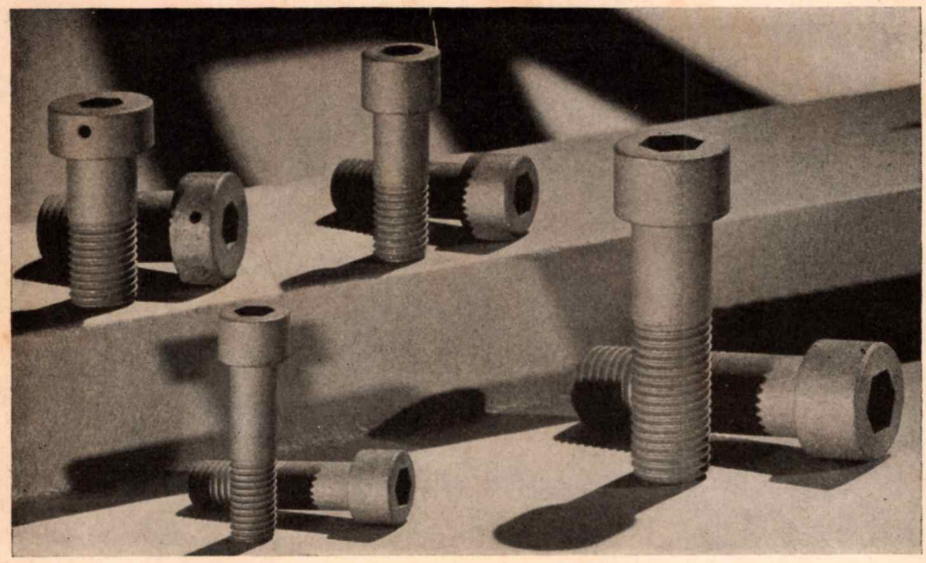


Various types of socket head cap screws designed especially for aircraft applications

SOCKET HEAD CAP SCREW DESIGN APPLICATIONS

W. C. STAUBLE

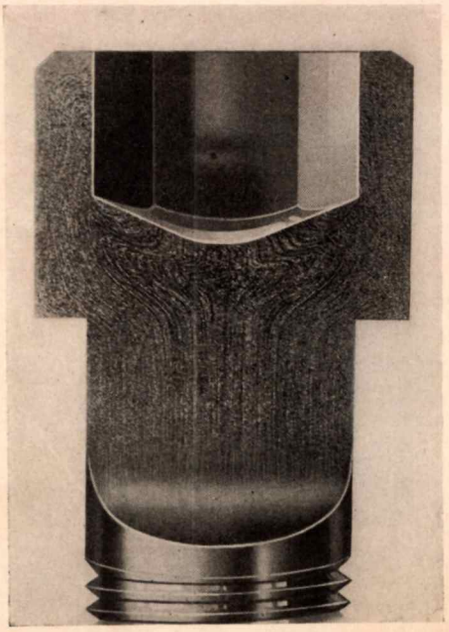
Vice-President, The Holo-Krome Screw Corporation

● Aeronautical engineers are probing the problem of designing a quality product producible by high speed methods which were untried in the industry as recent as even two years ago. These men have been aided in their work by innumerable devices—many specially developed for aircraft, others adapted for aircraft use because they could meet some particular need.

In the latter category should be placed the socket head cap screw, a device which has been used for years in other industry and which only now is finding acceptance in aircraft. Offering such advantages as savings in weight, space and assembly time, these products have inherent characteristics which foretell their widening adoption as aeronautical engineers become better acquainted with their capabilities and uses.

As a general rule, the possible advantages of using socket head cap screws is not so much in their design, but rather in the design of the parts on which they are to be used. Not only can they be applied to confined spaces where it would be inconvenient to use assembly tools, but they permit the designer to employ a more compact structure, with a corresponding saving of weight and a more efficient streamlined contour.

Principal feature of a socket head cap screw is that it has an internal driving principle in which a key is used to effect tightening of the screw. This contrasts with the ordinary type of solid head bolt which employs an external driving principle requiring a wrench which must either fit around the outside or over the head of the screw. As indicated above, the internal driving principle allows a more compact design and construction in confined spaces, but this advantage also applies in open areas where the head of a screw must be inserted in a countersunk hole in order to obtain a flush surface.



Etched cut-away section of socket head cap screw showing continuous fibre structure

One of the accompanying drawings illustrates a wall corner assembly and shows how space and weight plus compactness of design is possible through the use of a socket head cap screw as compared with conventional solid head bolt. This diagram graphically illustrates an assembly in which provision must be made for counterboring to allow for the setting down of the ordinary solid head bolt. It is evident that socket head cap screws do not require this extra counterbored area because of the internal driving principle and the type of L-shaped key used in tightening. An additional advantage is that less head room is required for the insertion of the key and the tightening of the screw. The L-shaped type of hex key that is used in tightening a socket head cap screw provides for six internal key hitches which, in cramped spaces or close corners, allow for an assembly which could not be accomplished by the use of solid head bolts.

In the Holo-Krome socket head cap screw it is possible, because of the method employed in manufacture, to have a full bearing surface underneath the head without the use of a washer face finish, and a perfectly flat smooth surface at right angles to the body. Under this method of manufacture no machining is done on the body of the screw at the juncture of the head or underneath the head. Whatever radius is required at the juncture of the head and body is incorporated in the screw as it is forged.

In a socket head cap screw it is essential: (1)—that the depth of the socket and the amount of metal between the bottom of the socket and the body of the screw be closely controlled so as to allow for maximum key leverage and maximum strength in the head of the screw, so that the screw will be properly tightened; (2)—that the screw is sufficiently strong to prevent the head from breaking away from the body; and (3)—that the sockets be uniformly accurate to the full depth of the hole, with the across flat section diameter identical top and bottom and without taper so as to allow for proper leverage of the key and prevent deformation of the socket when tightening. To achieve these qualities, Holo-Krome completely cold forges the entire screw, with the exception of the threads. The forging is done from the solid stock and no drilling, machining or broaching is employed in forming the screw. In this method, fibres of the steel

(Continued on page 139)

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Speed Nut System

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OVER A BILLION IN USE—OVER 700 SHAPES AND SIZES

ALUMINUM, DEFENSE, AND YOU

WE INTERRUPT our regular messages to report what's what with aluminum.

AT THE MOMENT delivery for civilian use must make way for defense. Everybody knows the reason. Defense requires and is using more aluminum per month than peacetime America ever consumed.

NEVERTHELESS, we intend that no one shall have to forego the things aluminum can do best one minute longer than we can help.

THERE IS NO SHORTAGE of bauxite, nor of anything else, except time. And Father Time is being given the race of his life.

WE ARE MOVING, for example, 35,000 yards of earth a day at Alcoa, Tenn., to get 50 acres under a single roof by September. It will require 193 carloads of roofing felt. Some of the operations in that plant will start even before the walls are up. That's an annual rolling capacity for 120 million pounds of high strength alloy sheet coming along fast.

LAST MARCH WE STUCK the first shovel in a cow pasture near Vancouver, Wash. In September a 30 million pound plant was delivering metal. It has been doubled, already. A third 30 million pound unit starts delivering in April; a fourth in May; a fifth in June. From cow pasture to 150 million pounds annual capacity in 15 months.

A SIDELIGHT: To make that 150 million pounds of aluminum, we first have to build factories to make 120 million pounds of carbon electrodes. We have to obtain the equipment (transformers, rectifiers, and the like) to feed 162,500 kw. of electricity into the reduction furnaces. This is a generating capacity equal to that of the state of Delaware plus twice that of Mississippi.

WHAT OF TOTAL PRODUCTION? In addition to Vancouver, further installations are being made at other of our plants, so that in less than a year their total capacity will be more than double that of 1939, when 327 million pounds were produced.

IN THE VERY MIDST of this demand we have lowered the price of aluminum ingot 15%. We state, without reservation, our hope that the price can be still further reduced.

DEFENSE PRIORITIES on aluminum simply say that there are some fundamental things that aluminum does supremely well. It will do them still better as important lessons in production, fabrication, and application are learned from every additional pound being produced and used.

ALUMINUM COMPANY OF AMERICA

(Continued from page 136)

in the screw continue uninterrupted, unbroken and uncut around the socket bottom between the socket and the shoulder of the screw, to terminate in the socket wall. This retains in the screw all of the advantages of the original properties of the steel, and imparts such additional advantages as are gained through the cold forged method of manufacture.

The photograph of an etched and cutaway section of a socket head cap screw manufactured by this method shows the core fibres not only are retained, but they maintain their continuity. They have been laterally deflected to form the base of the socket and are compacted to add to the strength at the portion between the socket and above the shoulder, this being essential as the head is the heart of a socket screw. Another feature is the fact that the fibres in the shoulders run parallel to the work load, giving greater strength where the load is applied. These screws, being completely cold forged in dies, have a head which is concentric with the body without the necessity of machining. In addition, the finished surface is exceptionally smooth.

Industry in general now recognizes the advantages of a continuous fibrous structure in a finished product, particularly where the product has recesses, depressions or sockets such as are employed in socket head cap screws.

Socket head screws are now being used as wing bolts. In the design of this bolt, weight has been saved by tapering the head without sacrificing strength or holding power. These socket head cap screws have rolled threads held to exceptionally close tolerances heretofore thought impossible of achievement in volume production and have ground bodies with a straight tensile strength of 180,000 p.s.i.

It has been common practise to evaluate the strength or holding power of socket screws in terms of straight tensile strength. However, in actual cases where a socket head cap screw is being tightened—that is, loaded—it is always subject to a combined tension and torsion load. Arriving at this fact, Holo-Krome developed the Ten-Tor Testing Machine which determines and registers the strength of a screw under this combination of loads; namely, tensile and torque.

The Ten-Tor demonstrates clearly that it is not possible to take full advantage of the tensile strength of a screw as shown by a straight tensile test.

As the result of extensive tests over a period of years, it is the author's opinion that the yield point of a screw is the more important factor to determine. Actual tests on the Ten-Tor machine, which determines the yield point or the actual point at which deformation takes place, proves that the yield point on a Holo-Krome socket head cap screw is from 20,000 to 40,000 p.s.i. less than the strength recorded in a straight tensile testing machine. It must be taken into consideration that the results of these tesis have been only the actual loading of the screw with no other stresses taken into consideration.

In operation of the Ten-Tor machine, the socket screw is placed in a fixture which seats the shoulder of the screw against the counterbored hole. Spacers are then placed over the unthreaded and part of the threaded section of the screw. Then the threaded portion is screwed into a nut held in a fixed position, the spacers being used to prevent the nut from running up the unthreaded portion of the screw. The hydraulic drums are started in action by a hand lever—and while they operate in unison the loads are recorded independently and show the actual torsional and tension load applied to the screw.

Socket head cap screws can be furnished to dimensional requirements as now specified for solid head bolts as far as tolerances are concerned, and where necessary can be furnished with ground surface and threads rolled to close tolerances specification. They are available in special analysis chrome nickel alloy steel or special materials such as dural, aluminum, brass, bronze, stainless steel, *etc.*

Standards covering dimensions of socket head cap screws for machine and tool assembly are available. However, for aircraft construction, there is now being formulated new standards which will allow greater head diameter in ratio to the body than are now available.

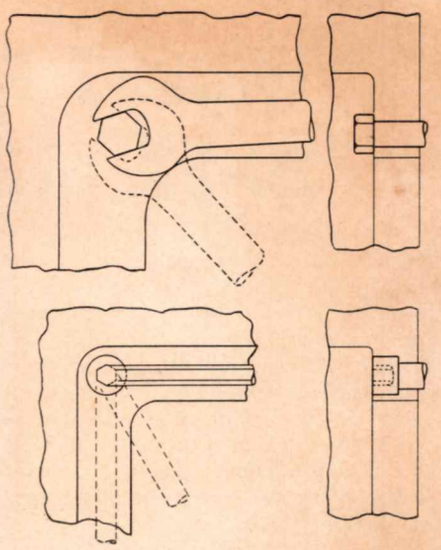
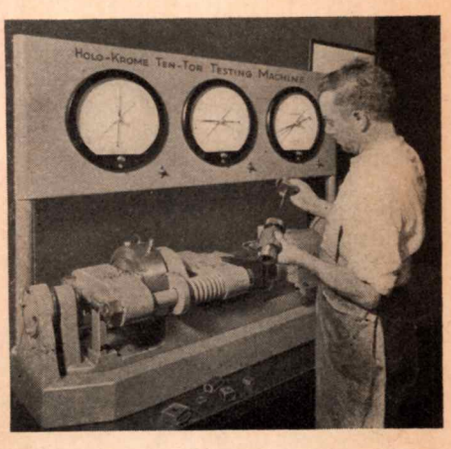
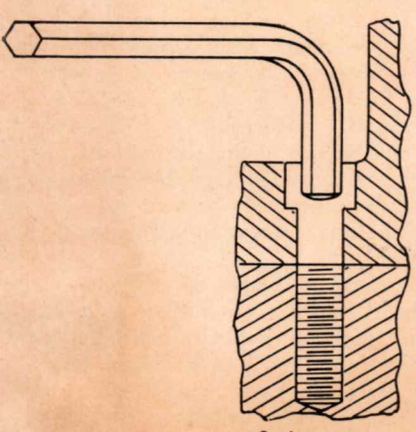


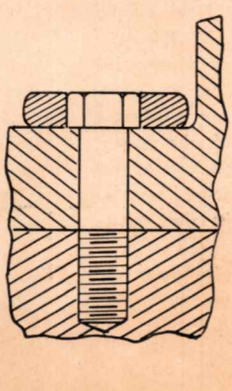
Diagram showing how weight and space is saved by using socket head cap screws



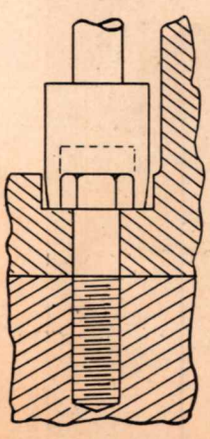
The "Ten-Tor" machine for testing tension and torsion in screws. (Below) Special wing bolt, having a tapered head to reduce weight without sacrificing strength



Socket screw and key



Solid head bolt and engineer's wrench



Solid head bolt and socket wrench

WRIGHT FIELD'S NEW 20-FT. WIND TUNNEL

● The 20-ft. wind tunnel now under construction at Wright Field will supplement the Field's two existing tunnels, one of 5 ft., the other of 14″ jet diameter. Made of 700 tons of sheet and structural steel, this new tunnel will be a closed tube type, of circular cross-section, varying in diameter from 45 ft. to 20 ft. at the testing section. The total circuit length, along the center line of the tunnel, will be 616 ft.

The model-testing section of the tunnel will actually form part of a 68-ft.-high test building made of reinforced concrete and built to withstand a differential pressure of 400 lbs./ft.^{2} This structure will be 108 ft. long and 62 ft. wide and will contain all instruments for automatically measuring and recording on a central control panel a model's reactions.

In one end of the test chamber will be an air-conditioned, soundproof control room, sealed off from the tunnel. Here engineers will be able to work in normal outdoor pressures and observe through sealed windows the models being tested.

The model will be suspended in the test chamber by three struts connected with a balance at the top of the test building. Its position will be regulated by remote control. As the air stream flows through the tunnel, the air forces acting on the model will be transmitted through the supporting struts to scales in the balance room and thence to automatic recording and indicating equipment in the control room.

In this wind tunnel, models of a possible 15-ft. span will be subjected to a wind stream which will simulate actual flying conditions at speeds in the neighborhood of 400 mph and at air pressures comparable to those at altitudes of from 3000 to 4000 ft. The larger of the existing Wright Field tunnels will accommodate models with wing spreads no greater than 4 ft.

Because of the ability to increase both the size of model planes and the speed of the air stream in the new tunnel, the Air Corps will be able to obtain more accurate performance information, effecting improvements in the Army's projected aircraft.

Ordinary model tests at Wright Field in the past have been made at an air speed of about 100 mph and the engineers were required to use this figure as a basis for their calculations as to the actual performance of a full-size plane. With speeds four times greater at their command, the investigators will be able to simulate actual flying conditions more closely. The larger diameter of the new tunnel will also permit tests on larger models of airplanes and thereby permit more representative performance results. In addition, the new tunnel will allow tests of full-size propeller and nacelle or engine installations under actual flying conditions.

While the air will travel through the 45-ft. section of the tunnel at 100 mph, its velocity will be quadrupled when it enters the 20-ft. test section. This increase in velocity results from the necessity of passing the same amount of air through the 20-ft. section as passes through the 45-ft. section in the same interval of time. A portion of the pressure energy in the large-diameter slow-speed section is changed to velocity energy in the small-diameter high-speed section. One result of this change will be a drop of approximately 30° F. below that of the air in the rest of the tunnel.

The most important types of wind tunnel tests conducted at Wright Field are those pertaining to performance and stability, pressure distribution, drag, and flutter. The work of the men at Wright Field is directed primarily toward practical aspects of flying military aircraft as distinguished from pure research.

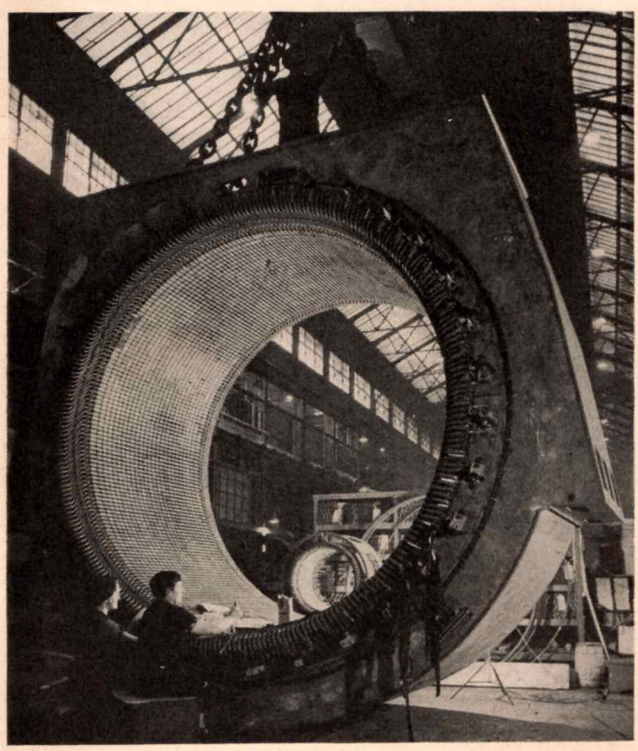
Into this new wind tunnel will go the largest motor of its kind, a 40,000 hp unit which will drive air at the required 400-mph velocity. It is expected to be installed and ready for operation at the Field by July 1. It is being built at the East Pittsburgh Works of the Westinghouse Electric and Manufacturing Co.

Of the wound-rotor induction type, the motor weighs 125 tons and stands about 15 ft. high. With its 50-ton rotor removed, there is room enough to drive a small truck through its core. Its 40,000 hp will be transmitted through a steel shaft 16″ in dia., and when operating at top speed, it will consume more than 30,000 kilowatts of electricity.

Despite its size, the speed of this induction motor can be varied from 37 to 297 rpm. In conventional applications of this type motor, the speed would be regulated by rheostats and a series of resistances, through which the excess power would be used up as heat when the motor was operating at reduced speeds. Air Corps engineers, however, have eliminated much of this waste of electrical energy by a system of two motor-generator sets, which are also being built by Westinghouse.

All of the power equipment will be housed in a separate building. The main motor will be connected, by more than 120 ft. of shafting, to two fans inside the wind tunnel.

The fans have 16 blades with a combined weight of 12 tons. Each fan is 40-ft. high, and as their blades force the wind through the tunnel at top speed, a retaining force of more than 200-tons per blade is required to prevent each blade from tearing away from the hub. Their thrust will be from 60 to 70 tons.



Wind speeds of 400 mph to test airplane models in the new wind tunnel at Wright Field will be generated by this, the largest wound-rotor induction-motor ever built. Here is the stationary member of the motor, which will deliver 40,000 hp, as it neared completion in the East Pittsburgh Works of the Westinghouse Electric and Manufacturing Co.

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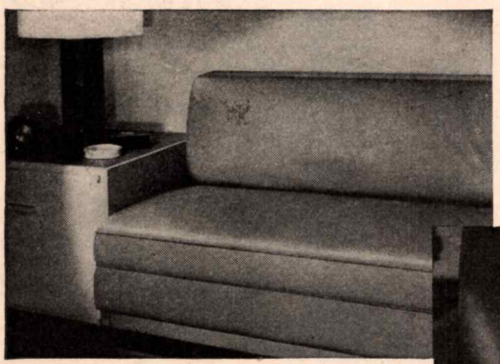

- LIGHTWEIGHT
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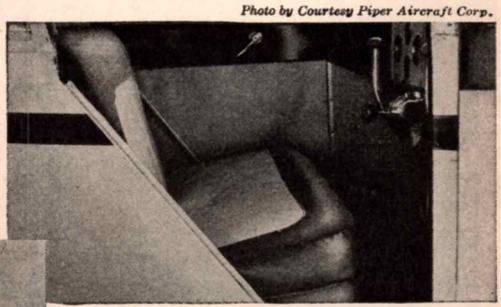
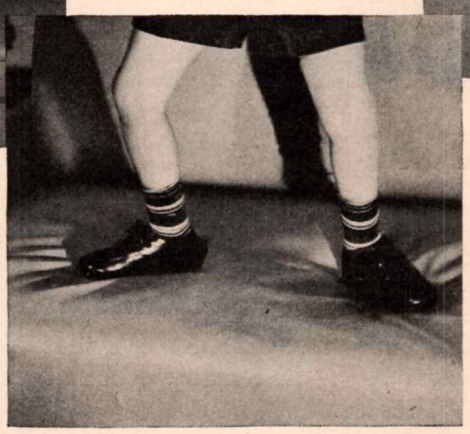
- LOW ORIGINAL COST
- LONG-WEAR ECONOMY

Photo by Courtesy Piper Aircraft Corp.





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The entire cabin can be lined to match or harmonize with Naugahyde seat upholstery —with Naugalite headlining, still lighter weight but in identical colors and grains.

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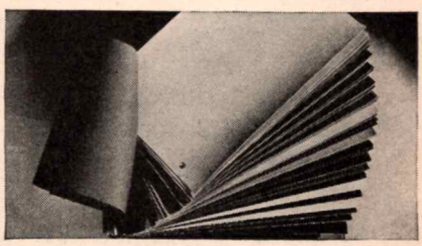
A damp cloth, or mild soap and water, easily whisks grime away.



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Naugahyde can take it

Naugahyde is made to stand abuse—it's full of *tough* leather fibres. It contains no oil to dry out and make it crack. Rubber makes it *naturally, lastingly* flexible. That's why Naugahyde wears smooth and crack-free so many years on the softest, deepest cushioning. Naugahyde offers another advantage (besides economy) over much costlier upholstery: deep-cushion "flexing" does not make it "bag" or "grow" permanently out of shape.

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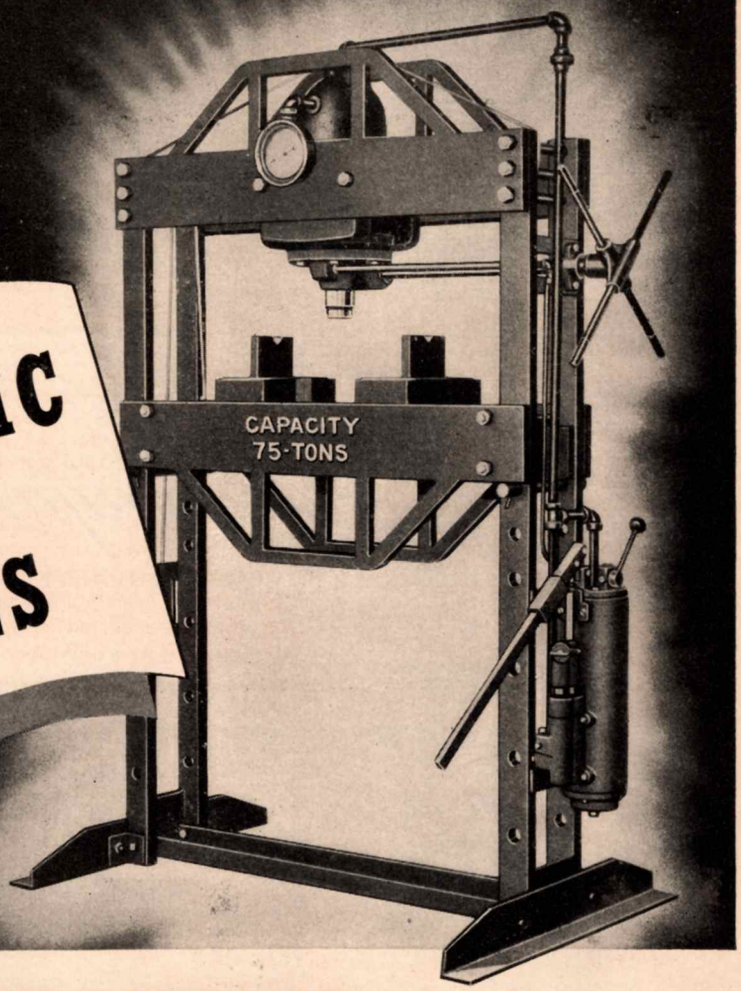

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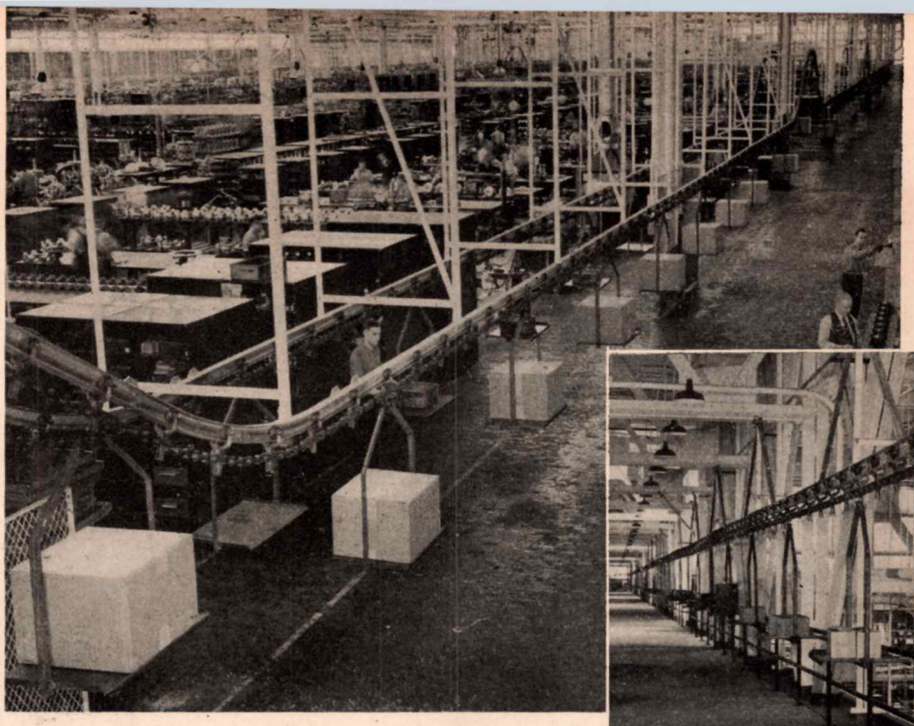
FACTORY EXPANSIONS in the AIRCRAFT INDUSTRY



Conveyor system serving the main-floor storage area in the new Pratt & Whitney Aircraft engine assembly building. The mezzanine floor contains storage space for the lighter, finished engine parts. Heavier parts are stored on the main floor

● As the industry swings into high gear to meet the gigantic production program resulting from energized national defense and all-out aid to Britain, practically every aircraft manufacturer is engaged in some sort of an expansion program of his own. Increasing orders necessitate increased facilities in a considerable number of instances, and in view of a contemplated 6 billion dollar backlog by 1942, the industry is gearing itself to the task of supplying every demand made of it.

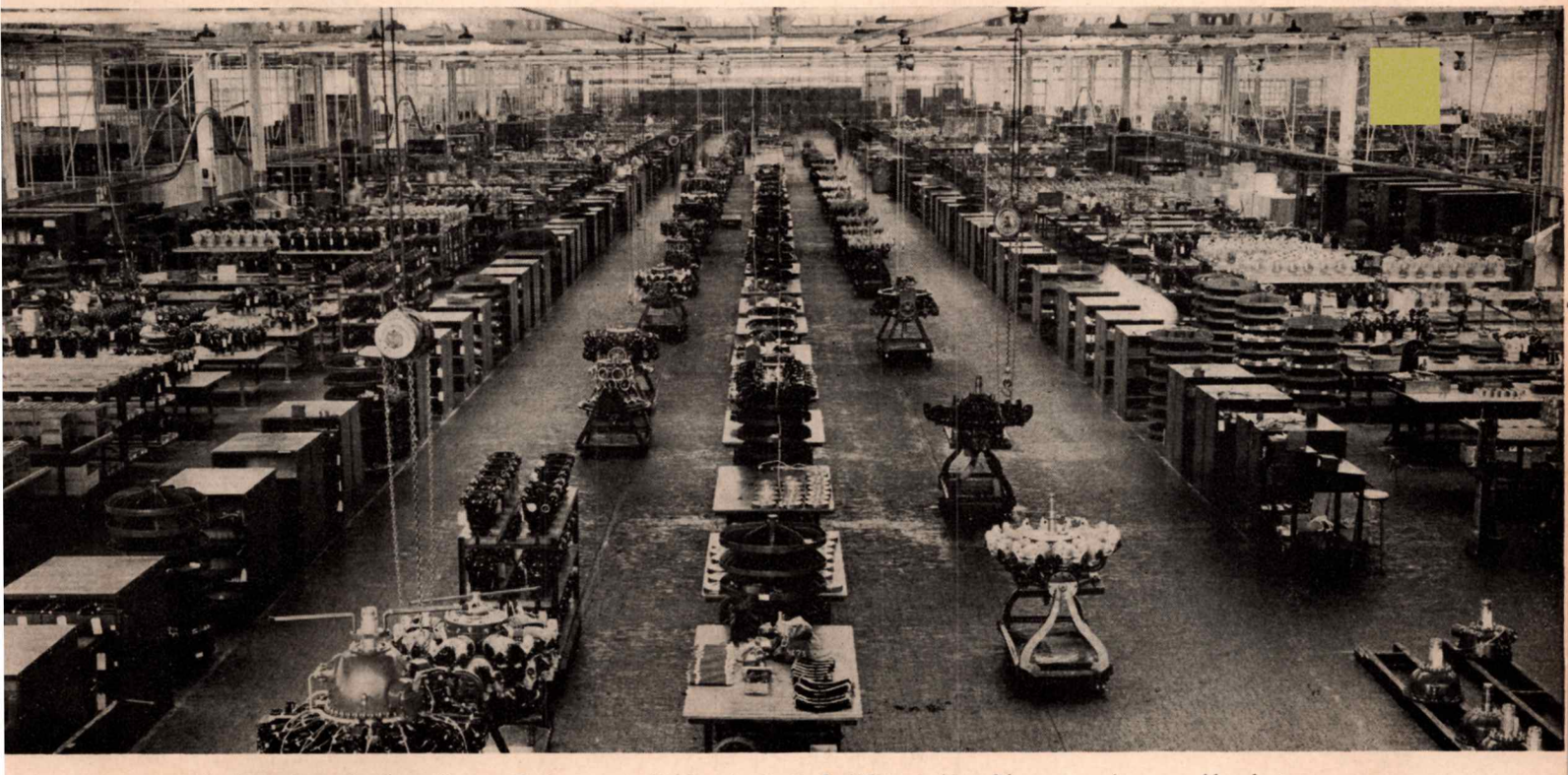
Of note in this expansion, is not only the widening adoption of devices to increase production flow, but the speed with which new quarters are occupied so that little time is lost in the move.

PRATT & WHITNEY

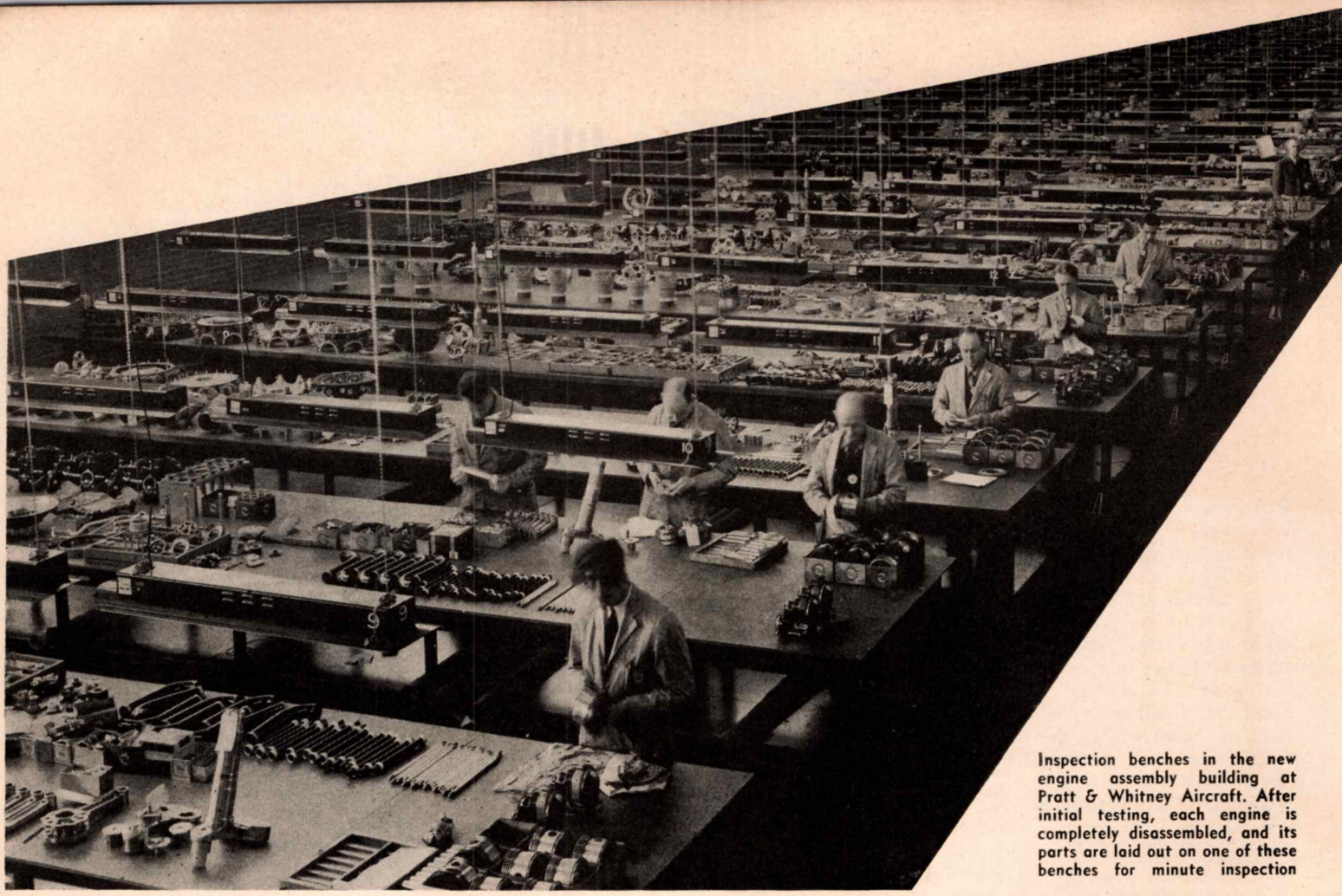
An example of the latter is seen in the newest of the four units built by Pratt & Whitney at Hartford during the past two years. Identical in size to the original P & W plant of 1938, the new unit totals almost 400,000 sq. ft. of floor space to be devoted solely to assembly operations. The move into this plant was carried out over a week-end and accomplished so smoothly that assembly operations began on Monday as scheduled and proceeded without a hitch.

Plans for the move were first undertaken early last fall. A small planning group worked out the plans to the most minute detail—determining the location in the new building of every piece of equipment and, at the same time, working the transfer of these items into a general schedule. The schedule had to provide for the conveyance of more than 400 engines in various stages of completion; of 371 inspection and assembly benches, representing a total area of 24,800 sq. ft.; 780 bays of steel shelving, representing 23,900 sq. ft. of storage space; approximately 340 large disassembly racks; and 400 hoists.

The date set for the beginning of the move was Friday, Jan. 31. On that day, at 3:30 p.m., almost 1000 men were as-



Looking down the "green" or preliminary assembly line in Pratt & Whitney Aircraft's new engine assembly plant



Inspection benches in the new engine assembly building at Pratt & Whitney Aircraft. After initial testing, each engine is completely disassembled, and its parts are laid out on one of these benches for minute inspection

sembled to do the job. Half of them were assigned to the new building and half to the old assembly department. While those in the new building cleared the way for the incoming traffic and marked on the floor the location of every machine, table, bench, bin and shelving bay, the others were marking each engine, each part and each piece of equipment with a tag giving its new location. Those not occupied in this work were maintaining the assembly of engines in the old building.

A fleet of 8 tractors and 4 electric trucks, meantime, began hauling loose equipment to the assembly building some 400 yards away. Crews of electricians and pipe fitters started cutting out power lines, compressed air, and oil and kerosene lines in the old, and as fast as a machine was slid into place in the new building the necessary hookups were made.

Heavy machinery and equipment was dragged into the new plant on skids behind tractors. Engines were transferred intact on their stands. Small parts were loaded into a collection of 5 tons of metal boxes, several hundred wooden boxes, or placed aboard disassembly racks for the move. Some men were appointed "spotters" to direct the loads to their destinations. At each destination point a crew of men, headed by a foreman, took charge of the loads delivered and saw that each item was properly located and ready for the moment when operations in the new building would begin.

The moving process went on through Friday night and continued Saturday and Sunday, let-ups occurring only at meal times and when relief shifts came on. Engines were built in the old assembly department through Saturday afternoon, then operations were shifted to the new building. The move was completed on Sunday night at 9:40 and the new facilities were ready to continue full production operations.

Within the next two days production was smoothed out in the new building, and on Wednesday a new high in daily output of aircraft engines was established, the daily rate for the previous month being increased by 10 percent.

Also known as Plant F, the new addition includes more than 330,000 sq. ft. of actual manufacturing floor space entirely devoted to engine assembly operations and related departments, such as finished stores, service stores, and bond rooms. Some of these store-rooms are for small parts and are located on a mezzanine floor, while store-rooms for larger and heavier parts are on the main floor. Cafeteria facilities, locker-rooms, first aid rooms, and shipping facilities occupy the remaining space.

Engine parts manufactured in the other P & W buildings converge on the new addition for assembly into completed engines. A continuous and automatic conveyor system distributes these parts to the various store-rooms or delivers them from the store-rooms to stations on the assembly floor. The conveyor is almost a mile long and can carry a live load of 65,000 lbs. at speeds of from 10 to 35 ft./min. Power is provided by two 3 hp motors.

The conveyor system and other features of the building were installed to allow straight-line assembly. Under this principle, parts are drawn from the store-rooms as needed and are placed on the conveyor for delivery to various sub-assembly stations. On completion, a sub-assembly goes to one of the two "green" assembly lines—one for single-row and one for double-row engines—which extend down the length of the building, parallel to each other. Further along is the final assembly line, similarly divided for single-row and double-row production. Above each is an overhead monorail equipped with chainfalls and a series of switches. The switches make it possible to shift heavy parts up or down a line at any time, or to shunt a "slow" engine to one side temporarily and thus maintain an uninterrupted flow of production.

The stands on which engines are assembled on the green and final lines roll in steel channels sunk into the floor.

Near the final assembly line are specially lighted inspection benches, where parts of engines which have gone through preliminary testing are examined. Suspended over each bench is a row of fluorescent lights which give out diffused daylight in such fashion as to totally eliminate shadows—a feature increasing the efficiency of inspection.

To facilitate transportation of engines from the assembly lines to the test houses and back, a 1600-ft. enclosed passageway

(Continued on page 147)

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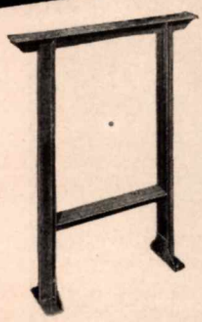
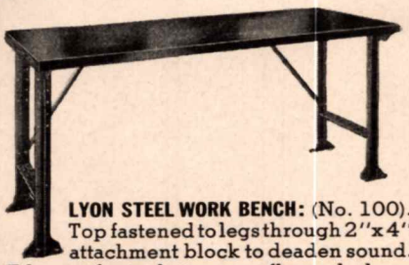


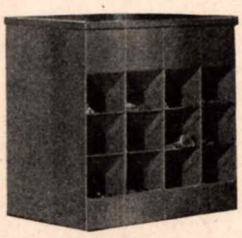
LYON STEEL BENCH LEGS: (No. 2993-11). Durable, for wood and steel bench tops, wood tables, machine mountings and bulk storage platforms. Top and bottom cross members are punched on 3 inch centers for attachment of top and shelf. Upright members punched for attaching stringers or cross bracing. Exclusive features: (1) riveted and welded; (2) reversible front to rear. 28" deep, 32-1/4"high. Finished in green baked enamel. Shipped completely assembled. Ship. wt. 27 lbs. **Price $2.95.**



LYON STEEL WORK BENCH: (No. 100). Top fastened to legs through 2"x4" attachment block to deaden sound. Edges of steel top are flanged down 1-3/4" and back 1-1/2" on both front and rear edges for strength and smoothness. 28" deep, 72" long, 34" high. Finished in green baked enamel. Shipped knocked down. Ship. wt. 145 lbs. **Price $14.30.**

Patent No. 2-202-427

LYON "ADJUSTABLE BACK" STEEL STOOL: (No. 1226). Welded, nonbreakable. Unusually large, comfortable seat area — 187 square inches. Long life pressed wood seat applied over steel for strength. Forged steel dome shaped foot, 1-1/8" in diameter, assures easy sliding without damage to floors. Green baked enamel finish. Height — 26". Shipped assembled and bundled — not packed or crated. Ship. wt. 14.1 lbs. **Price $2.85.**

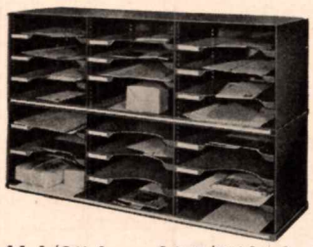


Pat. Applied For

ASSEMBLER'S BENCH BIN: (No. 2963). Accessible storage of 12 different parts in only one square foot of bench area. Individual hoppers (filled from top) are self-feeding. Built of steel and finished in green baked enamel. 16-1/4" wide, 9-1/4"deep, 15"high—overall. Hopper front openings are each 4"wide and 3" high. Loading compartments at top are 4" wide and 3" deep. Ship. wt. 19 lbs. **Price $5.70.**

LYON TOOL STAND: (No. 2970-17). Portable. Flanged top and trays prevent tools and parts from falling off. Includes drawer and padlock attachment — no padlock. Sturdily built — will remain rigid after hard use. Width 24", depth 24", height, with swivel-type steel casters, 37-1/8". Green baked enamel finish. Shipped set up. Ship. wt. 80 lbs. **Price $11.35.**

LYON SHOPROBE: (No. 2065-12). Portable. Double face —20 person capacity. Equipped with 20 non-removable coat hangers. Accessory equipment — chain to run through sleeve of coat and lock with a padlock (not furnished) to the compartment door. Diamond perforated doors. Overall size—50" wide, 36" deep, 75-7/8" high. Finished in green baked enamel. Shipped set up with standards and base detached. Ship. wt. 415 lbs. **Price $52.10** — without chains. (Price of chains 60c each. Ship. wt. of chains 2 lbs. ea.)



ADJUSTABLE SORTING RACK: (No. 2285-1). Has 9 shelves, adjustable every 1/2", forming 12 compartments. Shelves are equipped with label holders. Bottom flanged for stacking. Two racks are illustrated. Sorts mail, shipping papers, job tickets, and stores small tools and sandpaper. 34-1/4" wide, 11-1/2" deep, 10-5/8" high. Shelf width, 10-13/16". Finished in green baked enamel. Ship. wt. 34 lbs. **Price $11.90 each.**

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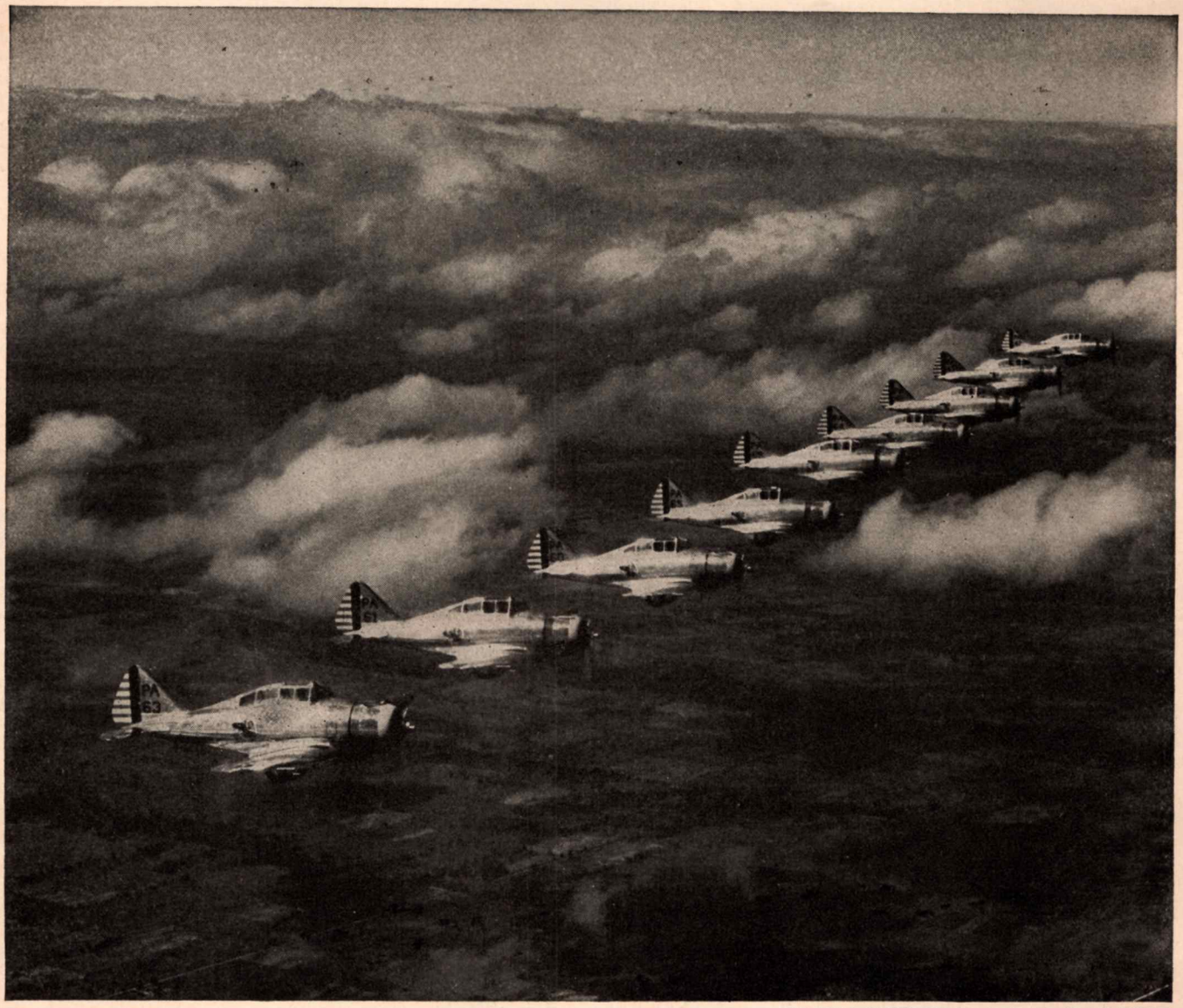

OFFICIAL PHOTOGRAPH, U. S. ARMY AIR CORPS

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THE H. A. WILSON COMPANY
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Branches: Chicago ★ Detroit

(Continued from page 144)

is being built alongside the new addition. It will house an overhead monorail system on which a number of engines at a time will be carried back and forth. The carrying units are to be electrically controlled.

At one end of the final assembly line is the packing and shipping department. Overhead on rails, are 5-ton electric cranes for transporting boxed engines to an enclosed and heated railway loading platform nearby.

Beneath the assembly floor are a basement cafeteria, first aid rooms and locker-rooms. The cafeteria covers an area of 14,980 sq. ft. and will accommodate 800 persons at a time. Adjoining are women's and men's first aid and locker-rooms, occupying 1588 sq. ft. and 13,168 sq. ft., respectively. The locker-rooms have facilities for 3400 persons.

The new building is of the monitor steel-and-brick type of construction, and brings P & W's total factory floor space to about 1,600,000 sq. ft. Designed by Albert Kahn, it incorporates two 128-ft. bays and one two-story 64-ft. bay on which the mezzanine store-rooms are located. The wide bays were chosen to facilitate straight-line assembly operations. Trusses for the bays were too big to be delivered already assembled on railway flatcars, as was done in the case of previous factory additions, so they were brought in piece-meal and assembled on the job. Approximately 3000 tons of steel went into the new building.

Heat is provided through overhead wing-type rotating units. Alternately spaced mercury vapor and incandescent lamps furnish illumination.

CURTISS-WRIGHT

The Curtiss-Wright Corp., already engaged in a large scale expansion program in Buffalo, Columbus, Cincinnati, and St. Louis, is now embarked on further plans for additional facilities.

Plans were announced for providing its Propeller Division with America's largest individual aircraft propeller-manufacturing plant to cost $5,221,100, and employ 4000 people. This factory, comprising 415,000 sq. ft. of floor area, will be built adjoining Beaver Borough about 20 miles northwest of Pittsburgh, on a 32-acre site. It will be of one-story, brick and steel construction with a two-story building for administrative offices.

Preliminary plans for the factory already have been drawn up and construction will be rushed to get production underway by late summer this year.

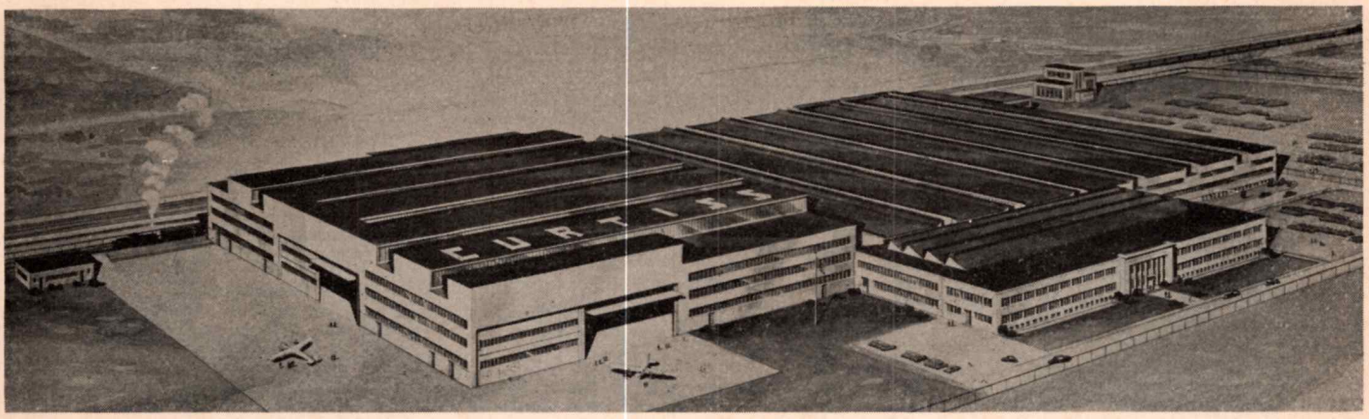
Supplementing the Propeller Division's present factories in Caldwell and Clifton, N. J., in Indianapolis and in Pittsburgh, the new plant will expand the organization's total production area to 1,415,000 sq. ft., and increase employment from the present figure of about 3000 to more than 15,000.

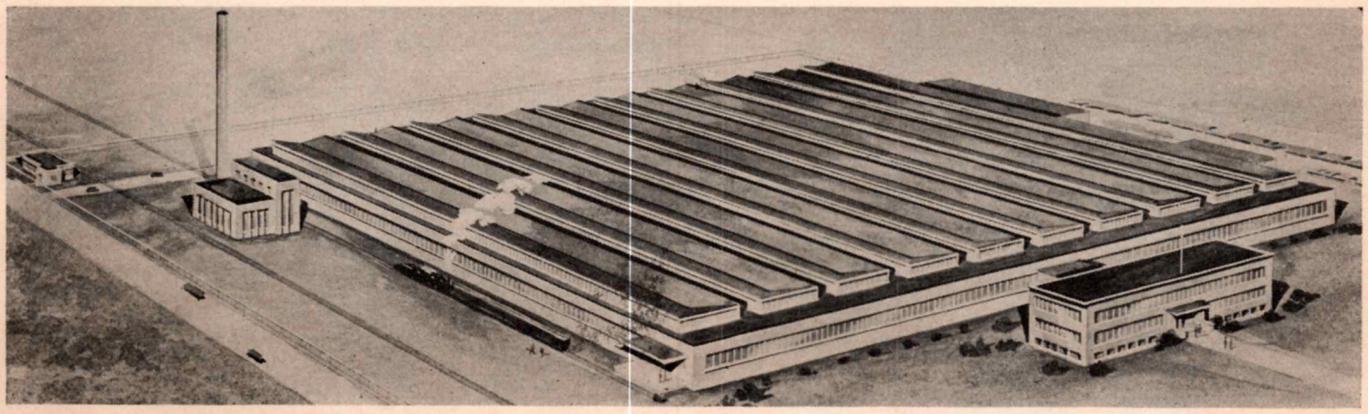
The significance of this expansion to meet the demand of the national defense program for Curtiss electric propellers is best illustrated by the fact that the Division comprised but 17,000 sq. ft. and employed 111 workers when it moved from Buffalo to Clifton on Aug. 1, 1938.

The Beaver site was selected after a survey of more than 30 tracts in and around Pittsburgh. The tract acquired adjoining Beaver Borough is now vacant land and is exceptionally level thus promising to expedite construction. It is bounded on the east by Tuscarawas Road, on the south by Georgetown Lane, on the west by Walnut Lane and on the north adjoins the N. J. Pew Estate.

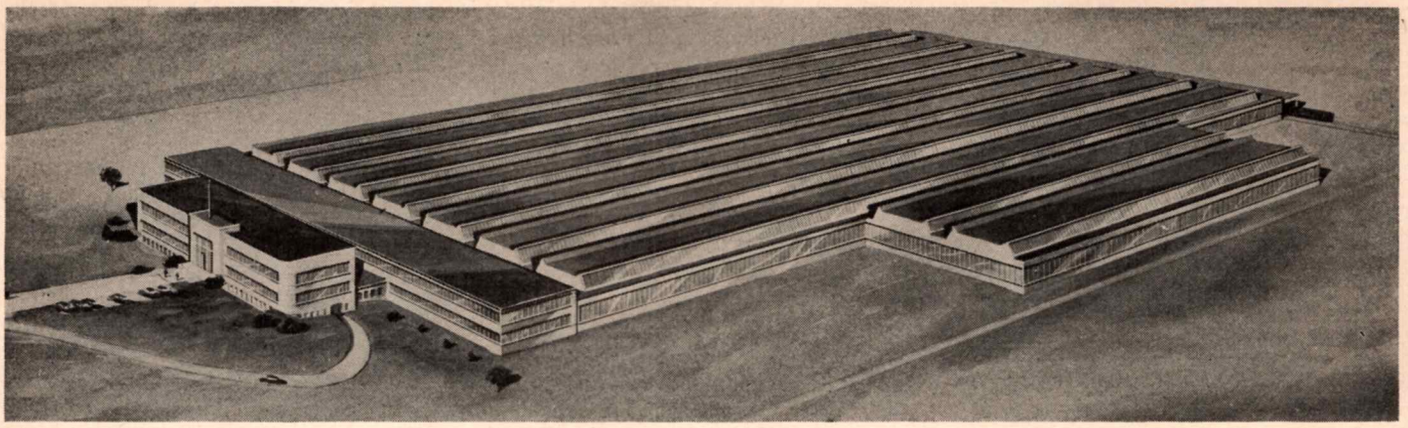
It marks the second factory to be established in the Pittsburgh area, Curtiss-Wright Corp. having acquired the hollow steel blade manufacturing division of the Pittsburgh Screw & Bolt Corp., in October, 1939. Then employing 200 persons, this plant now has 950 workers. The new expansion follows closely Curtiss-Wright's acquisition early this year of a 400,000 sq. ft. plant in Indianapolis for propeller production.

Also included in the corporation's expansion is a large experimental test hangar costing $100,000 to be built for the Wright Aeronautical Corp. on its air-





Curtiss-Wright plant at St. Louis, Mo. and (below) the Curtiss-Wright propeller factory near Pittsburgh, Pa. scheduled for completion late this summer



Thompson Aircraft Products' Cleveland plant

port in Caldwell, N. J. The new unit will be placed in operation late this spring.

The hangar will be of all-metal construction and will have a floor area of 15,600 sq. ft. It will be used to house the small fleet of planes employed by Wright to test *Cyclone* and *Whirlwind* engines.

At the same time, a new runway and other improvements for the Caldwell airport are to be made at a cost of $50,000. The runway, extending E-W, will be extended to 4200 ft.

Wright is now operating five plants totaling 2,842,000 sq. ft. and employing about 16,000 persons, and is rushing to completion a sixth plant of 2,120,000 sq. ft. at Cincinnati. This latter plant will employ from 12,000 to 15,000 workers, and will have 72 modern soundproofed test cells capable of testing engines up to 3000 hp. Contracts for the construction of these test cells were awarded last month to the Mahony-Troast Construction Co., Passaic, N. J., which is already engaged in constructing the aluminum foundry of the plant, and which is to build a 137,000 sq. ft. storage warehouse having outside dimensions of 405′ × 340′. At peak production, the cells will accommodate an average of 250 *Cyclone* engines a week. These cells will use 15,000,000 gals. of gasoline and 360,000 gals. of lubricating oil each year for the green and final test runs.

Frank Messer & Son, of Cincinnati, already engaged in constructing the main machining and assembly building, received an additional contract for the construction of a steel and concrete boiler house, measuring 125′ × 88′ and containing 11,000 sq. ft. of floor space.

Indications at this time are that the Cincinnati plant will be able to begin preliminary production operations this month. All machining operations up to the limits of machinery available will be started as soon as the first section is ready for occupancy. Wright is training men now on the machines they will actually use in production so that experienced personnel will be on hand to operate this equipment as soon as the plant is ready.

The aluminum foundry, which will contain 161,000 sq. ft. of manufacturing space, was about 70% completed early in March and was expected to be in operation in time to supply castings to the machine shop when it is completed. The aluminum foundry to cast the cylinder heads and other essential parts of the *Cyclones*, was to be ready by March 15 when core-making in anticipation of production of parts was to be started immediately.

Planned according to the latest and most modern industrial plant design, the new factory is divided into the following sections: Machining and Assembling Building, 1,640,000 sq. ft.; Aluminum Foundry, 161,000 sq. ft.; Magnesium Foundry, 118,000 sq. ft.; Office Building, 74,000 sq. ft.; Power House, 11,000 sq. ft.; and Test Cells, 116,000 sq. ft.

To prevent interruption of production once operations are started in the gradually completed sections, plywood will be used for intersection partitions to protect operators and machines from the elements and also from construction operations in adjoining sections.

If machines are available, a complete line will be set up temporarily in each section as it is completed in order to keep up the balanced flow of parts for the engines, despite the continuance of construction work in other sections.

REPUBLIC AVIATION

A new factory is now being rushed to completion for Republic Aviation Corp., at Farmingdale, L. I., N. Y., on a site directly opposite the present Republic plant and adjacent to their large flying field.

Another of Albert Kahn's designs, this manufacturing and assembly building will measure 900 by 500 ft. and cover more than 10 acres of open floor space. Scheduled for completion May 1, it will represent an outlay of approximately $5,280,000 including the operating equipment. Excavation operations were completed in 9 days; foundations were started on Jan. 13, and work is now nearing completion of the 4000-ton structural framework.

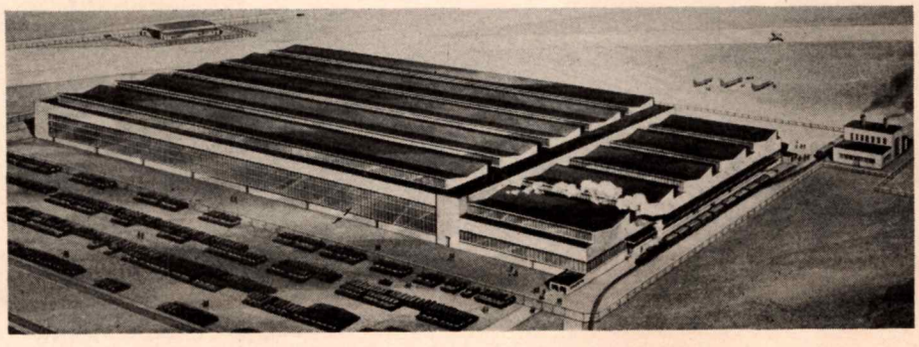
The exterior features the use of buff-colored, smooth-faced Speed Wall tile to a height of 7 ft. above the floor. Sash in the side walls, as well as that in the roof monitors are so designed that at a later date complete blackout shutters can be easily installed over them.

The main portion of the building which is arranged generally for assembly purposes, has a clear height of 35 ft. from the floor level to the bottom chords of the roof trusses. This working floor consists of three areas—the center, 800 ft. long by 200 ft. wide; and two side areas each 800 ft. long by 150 ft. wide; all of these areas are entirely free of columns or other structural members. The western end of the building, consisting of five 100-ft. wide bays, has a clear story height of 20 ft., and will be used for tool shops, stock rooms, *etc.*

Construction details are so arranged that future extensions may be readily added with minimum interference with

(Continued on page 151)

Republic's plant at Farmingdale, L. I.



SOUTH BEND LATHES

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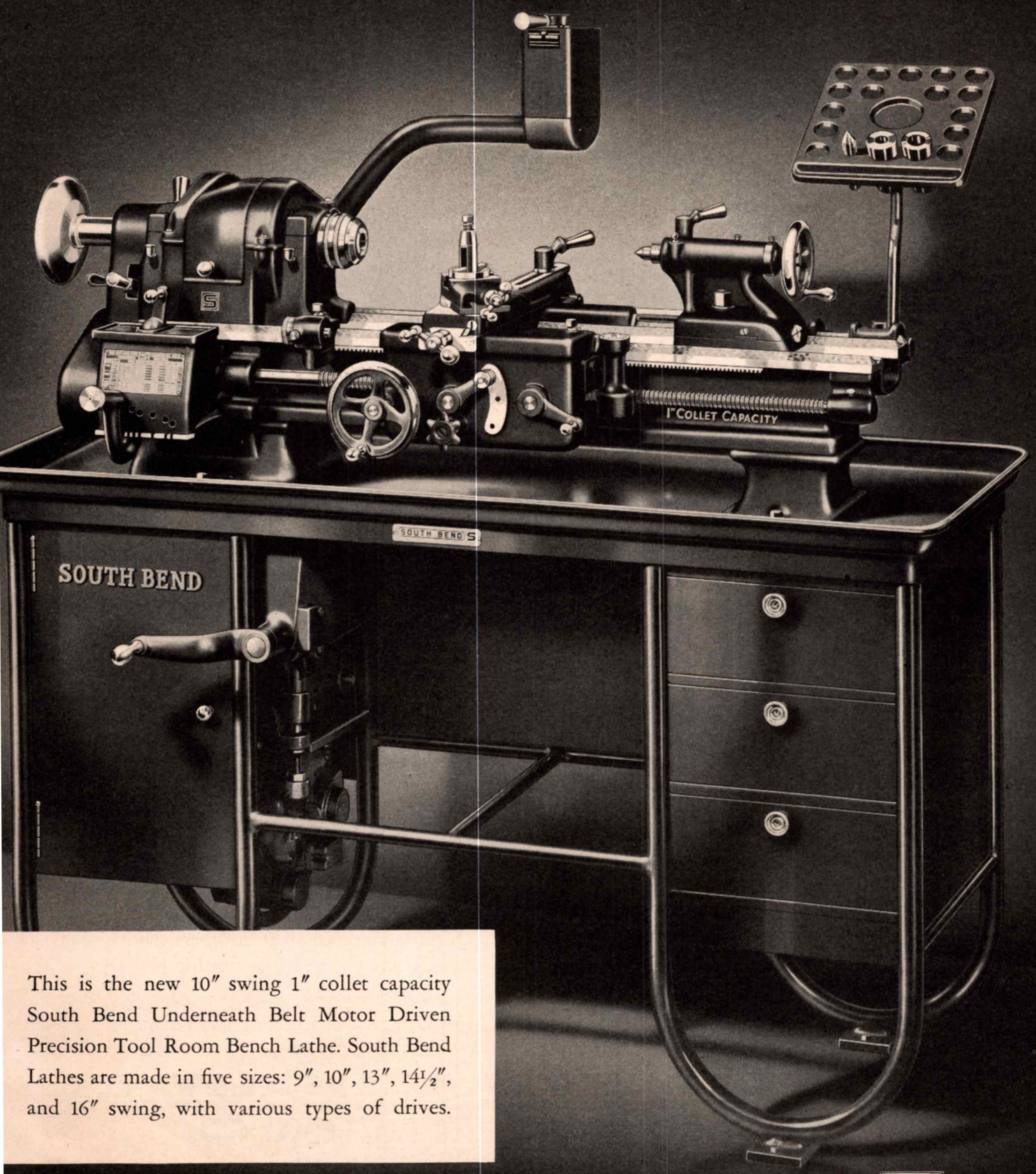

This is the new 10″ swing 1″ collet capacity South Bend Underneath Belt Motor Driven Precision Tool Room Bench Lathe. South Bend Lathes are made in five sizes: 9″, 10″, 13″, 14½″, and 16″ swing, with various types of drives.

TRADE MARK SOUTH BEND TWIN ENGINE LATHES

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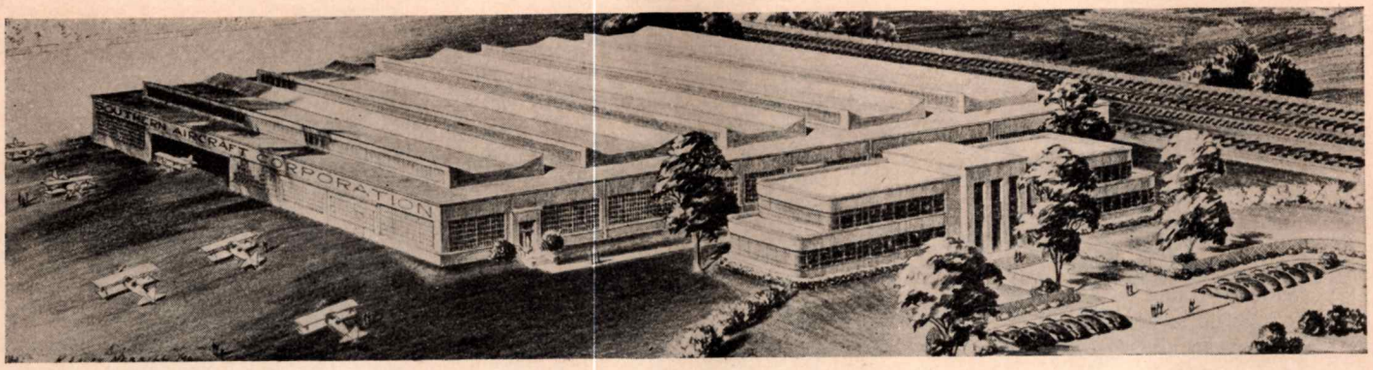


Artist's drawing of the new factory of Southern Aircraft Corporation, Garland, Dallas County, Texas. The view below shows the well-lighted tool room in the foreground

(Continued from page 148)

production. In addition to these extensions, an entirely separate office building for the engineering and executive departments is in process of development.

The eastern end of the building near which the final assembly operations are located, is provided in part with large canopy doors designed to open in two movements. At the first operation, the lower half of the door is lifted vertically until it is about level with the upper part. Both halves then swing on a central horizontal axis, so that in their final open position a canopy projecting about 17 ft. from the exterior wall line, is formed.

If desired, the entire eastern end of the building may be equipped with doors of this type. At present, however, one large doorway, which is 200 ft. wide by 35 ft. high and one smaller doorway 50 ft. wide by 35 ft. high are being installed.

Parking spaces for employees' cars are arranged west of the new building, these spaces being adjacent to the two employees' entrances.

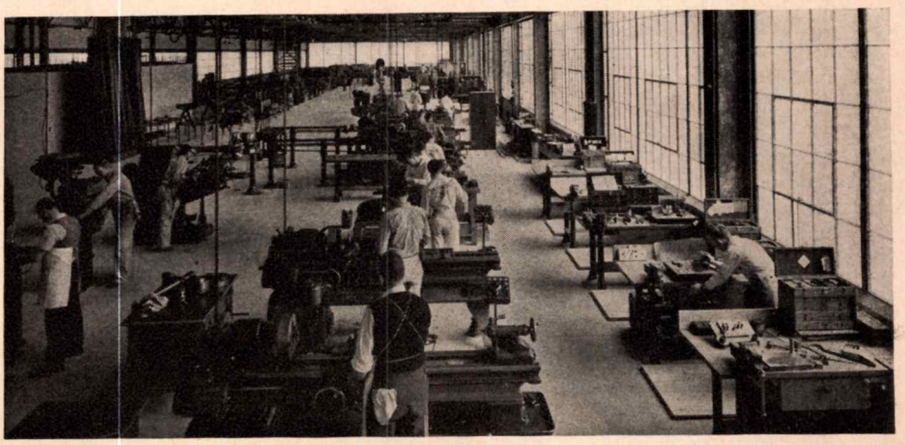
Entrances lead down a few steps to locker rooms, wash rooms and toilets, which are located below the working floor of the building. In this basement area fan rooms, duct spaces and ventilating equipment for properly conditioning the service rooms will be installed.

The electrical power distribution system, with transformer vaults, encased conduits, and electrical distribution units is also concealed entirely below the working floor.

A large cafeteria and kitchen to be placed in conjunction with the basement locker room system, will be provided in the future extensions to the building.

Heating and ventilating is provided by unit heaters arranged at frequent intervals in the roof, and so disposed that air may be drawn in from the outside, heated and recirculated or drawn out from the building, as desired.

The boiler house, adjacent to the building at the southwest corner will contain two oil-fired boilers, and three 1500 cu. ft. compressors. Space is also provided in this building for the servicing, charging and storing of 15 electric trucks.



SOUTHERN AIRCRAFT

Southern Aircraft Corp. is now in its new plant at Garland, Dallas County, Texas, where there are 100,000 sq. ft. of manufacturing space and 14,400 sq. ft. of office and engineering space.

The 23-acre plant site, adjacent to the company's 160 acre private airport, is located approximately 8 miles east of Love Field, Dallas Municipal Airport. The plant is of concrete, steel and brick construction, with continuous steel and glass sides. It is a monitor type building, the roof truss being supported by steel columns on 60-ft. centers. The long axis of the monitors is east and west, giving a desirable north-south, shadowless lighting throughout the entire floor area; blue tinted, heat absorbing and glare repellent glass is being used in the east, south and west sections. Fluorescent lighting is installed for night crews. Rock ballasted parking areas are being provided, and an 80-ft. concrete road will be built to the company's property connecting to the four-lane Dallas highway.

The company airport has been surveyed, and when grading is completed will offer a minimum of 2600 ft. in any direction, on a naturally drained, grass covered, all-weather field.

The building project has been planned by Gill and Bennett, engineers and architects of Dallas, Texas. Construction is in the hands of Henger Construction Company of Dallas, general contractors.

While the new plant was being built, production of parts for Southern Aircraft's Model BM-10 primary military trainer was in progress at the old Houston plant, with one full time day shift and a partial night shift operating.

BUICK

Announcement was made last month of the award of a $2,500,000 general contract for the construction of Buick's new aircraft engine plant at Melrose Park, Chicago. Equipment will be moved to the site and work started on the construction immediately. The contract covers completion of a main manufacturing building of more than 1,000,000 sq. ft. of production floor space, and general offices. The plant will be utilized for the production of 1200 hp Pratt and Whitney twin-row engines and will be operated by Buick under Government defense contracts totaling in excess of $125,000,000.

The contract calls for maximum speed in construction with stipulation of extra construction crews and two shifts daily, with Sunday and holiday work provided for if necessary to meet the time requirement. Plans also include installation of lights to accommodate night work necessary by the two shifts and other measures to expedite the development. The construction schedule will coincide with plans for equipping the plant.

The Buick plant will be one of the largest aircraft engine factories in the

country, and when completed is expected to produce about 500 engines a month. About 10,000 persons will be employed there.

RYAN AERONAUTICAL

Latest expansion program of the Ryan Aeronautical Co., and Ryan School of Aeronautics, involving expenditures totaling approximately $400,000, was nearing completion last month. The Ryan factory is being increased 100,000 sq. ft. in floor space to provide a total of more than 240,000 sq. ft.

Principal factory addition, which adjoins the north side of the Ryan plant on Lindbergh Field, San Diego, is 200 by 325 ft., of steel frame construction with saw-tooth roof, and will be used for sub and final assembly of Ryan S-T type military training planes for the U. S. Army Air Corps and U. S. Navy, and for storage of airplane parts.

An additional two-story section, 50 by 150 ft., on the west end of the main factory building has just been occupied and provides needed space for the expanding Ryan organization. This building has accommodations for factory superintendents, supervisors, inspectors and plant engineers, as well as for the testing laboratory, and tool design, lofting, layout, planning, materials control, estimating, time study and records departments.

Included in Ryan's latest expansion budget is a $150,000 item for new production machinery, tools and manufacturing equipment of all kinds.

Other construction under way includes a new and larger Finishing Building, 60 by 200 ft. to house the paint department; and a 50 by 175 ft. Service Building to provide facilities for the plant maintenance department, wood shop and storage.

Supplementing the production departments now and in the future to be established within the permanent buildings, the current expansion plan calls for 94,000 sq. ft. of asphalt and concrete yard paving which will provide facilities for certain types of production work which may be conducted outdoors practically the year round in Southern California.

Across Lindbergh Field from the Ryan manufacturing plant, the company's subsidiary, Ryan School of Aeronautics has under construction two additional two-story school buildings, each approximately 44 by 85 ft., adjoining the school's main offices.

The new unit on the north side of the main office will provide facilities for administrative and operations departments of the Air Corps Training Detachment, which provides flight training for the Army's flying cadets. Included in the building will be quarters for Flight Dispatchers, Flight Instructors and offices of Army personnel assigned to this station.

Complete new quarters for the Ryan Engineering School will be contained in the other new building unit now under construction. This building will have facilities designed to accommodate 120 students. Floor space given over to the expanded Engineering School will more than treble the area now provided. The Engineering School has been expanded in the past six months in an effort to meet the demands of Southern California aircraft factories for engineers trained in practical methods of the airplane industry.

BREWSTER

Announcement was made last month that a new 410,000 sq. ft. factory is to be built at the Philadelphia suburb of Johnsville for Brewster Aeronautical Corporation.

Expected to employ 5000 persons in the assembling of dive-bombers, the proposed plant will augment existing facilities at Newark Airport and Long Island City.

The new factory is to be built at the edge of an airport now under construction, and which will have three runways measuring 4100, 3600 and 3000 ft. in length. The airport and factory will cover a 372-acre site.

AEROPRODUCTS

The new plant of General Motors' Aeroproducts Division at Dayton is approaching completion and production of propellers in this plant is scheduled to begin in July.

Last June, General Motors acquired the propeller business of Engineering Products, Inc., which had been working on the development of a hydraulically controlled propeller for several years. It was anticipated that in the normal course of events the Corporation would begin the manufacture of propellers after about three years of preparation. Due to the national defense demand, however, development work was intensified and, with the cooperation of the Materiel Division at Wright Field, Dayton, a propeller recently passed Army tests.

Even before tests were made, and in anticipation of the demand for the propeller in the defense program, construction and equipment of a plant were begun last fall. The plant, a modern, air-conditioned factory, is now substantially completed, and, because of even greater increased defense demands, negotiations are now under way, looking toward more than doubling the size of the initial plant. The present plant contains 193,000 sq. ft. of floor space.

Standard sizes of propellers for high horsepower engines will be manufactured in the Aeroproducts plant. Initial production is to be on sizes adapted to the Army pursuit type of airplane.

When the initial program is in full swing, 1800 employes will be engaged.

Last year, Aeroproducts began construction of a propeller testing tunnel and laboratory. The laboratory is now ready for operation. In this laboratory, propellers built in temporary quarters occupied by Aeroproducts Division will be tested using Allison engines.

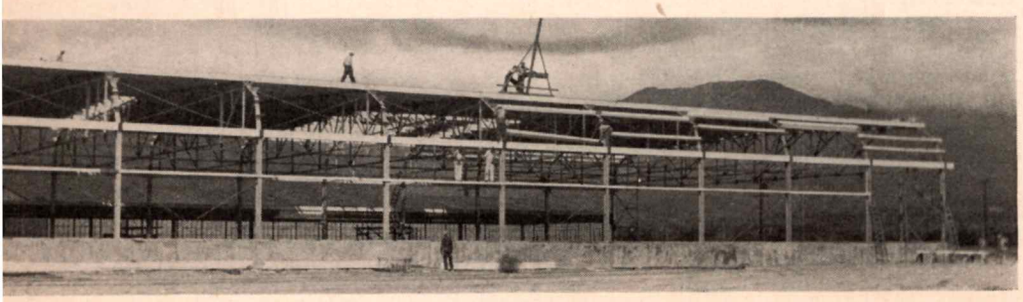
MORROW AIRCRAFT

Now rapidly nearing completion, a fully air-conditioned plant is soon to be ready for Morrow Aircraft Corp. Located at the new San Bernardino (Calif.) Airport, the new plant will house facilities for constructing the Model 1-L, a plastic bonded plywood trainer. Morrow has operated a precision products machine shop for some months, doing job contracting work for Lockheed, Aircraft Accessories, Northrop, Bendix and others.

This division of the business is on a two shift basis, and as rapidly as additional machine shop equipment is secured more personnel are being added to the machine shop department.

Recently added in the company is a specialized hydraulic development department in which will be produced a number of hydraulic accessories.

Morrow factory at San Bernardino Airport where a new plywood Trainer is to be built

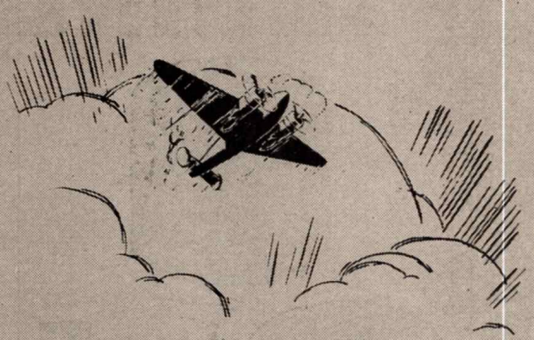


BELL AIRCRAFT

Feature of Bell's new factory now nearing completion at Niagara Falls, N. Y., is a movable floor assembly line moving at a rate of 1/3" per minute.

(Continued on page 190)

STRONG AND NON-MAGNETIC Heat-Treatable "K" MONEL..



THIS corrosion-resistant high-nickel wrought alloy is non-magnetic. Through heat-treatment it develops strength comparable with that of alloy steels. Its combination of excellent corrosion resistance and high strength make "K" Monel exceptionally well suited to structural applications in aircraft near the magnetic compass.

For parts produced in quantity by automatic screw machines, similar advantages are offered by the new free-machining high-nickel alloy "KR" Monel.

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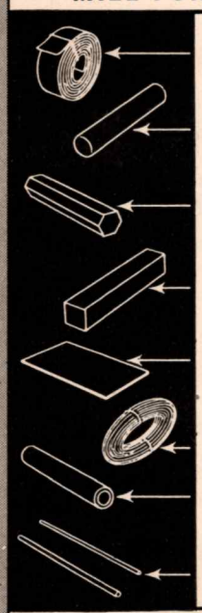
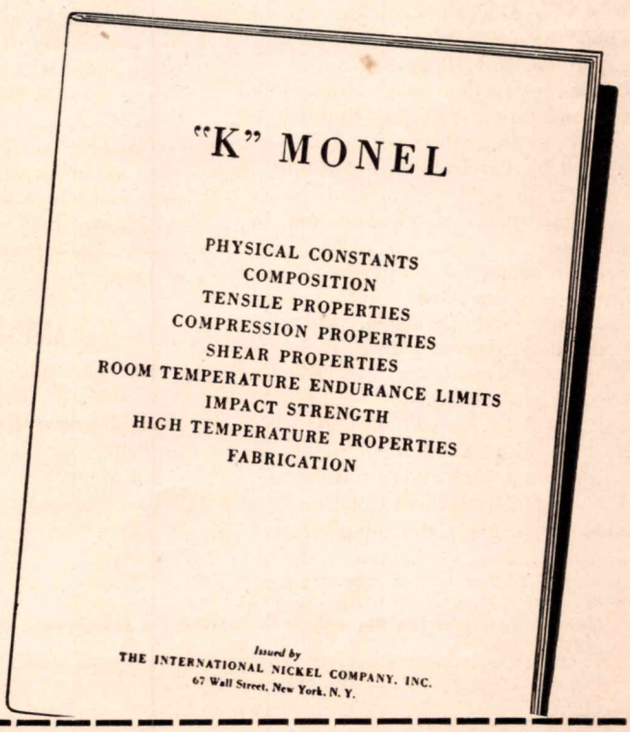
MILL FORMS OF "K" MONEL



Strip	**Thickness**—.001" to .250" **Width** —1" to 12"
Rounds **Hot Rolled** **Cold Drawn**	¼" to 3" diameter ½" to 3" diameter
Hexagons **Hot Rolled** **Cold Drawn**	⅜" to 2⅛" ½" to 1"
Squares **Hot Rolled** **Cold Drawn**	5/16" to 1" ½" to 1"
Flats **Hot Rolled**	**Thickness**—¼" to 15/16" **Width** —½" to 2"
Wire **Cold Drawn**	.003" to ¼"
Seamless Tubing **Cold Drawn**	**Outside Dia.**—½" to 3" **Wall Thick.**—.035" to .259"
Welding Rods **Gas** **Electric**	3/16" to 1/16" diameter 5/32" to ⅛" diameter
Forgings, etc.	**To order**



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*Name*_____ *Company*_____

*Title*_____ *Address*_____

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"K" Monel is a registered trade-mark of The International Nickel Company, Inc., which is applied to a nickel alloy containing approximately two-thirds nickel and one-third copper, with a small aluminum content that permits hardening by heat treatment.

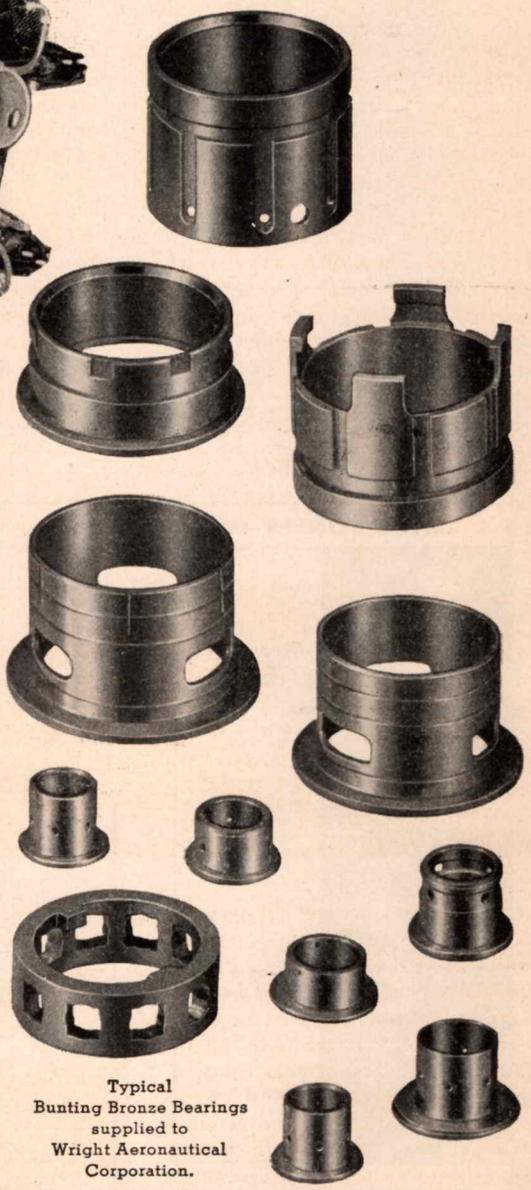
IN THE WORLD'S GREATEST AIRCRAFT ENGINES

WRIGHT AIRCRAFT ENGINES

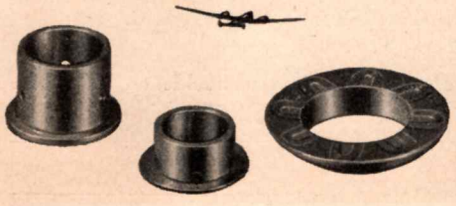
How American engineers and production men are meeting today's challenge is dramatically revealed by the record-breaking Wright Double-Row Cyclone 14 aircraft engine, rated at 1700 hp for take-off and 1500 hp for normal operation. This engine is approved for both Army and Navy, and bears an official A.T.C. for the highest power rating ever granted covering the commercial installations being made for Pan American Airways in the Boeing Clippers.

Many of the bronze bearings in this magnificent power plant are Bunting Bronze Bearings. To manufacturers of aircraft and all other mechanisms Bunting offers vast experience in bearing applications, precision manufacturing facilities and responsibility established by years of intensive specialization. Your inquiry does not obligate you . . . The Bunting Brass & Bronze Company, Toledo, Ohio. Warehouses in All Principal Cities.

● Developed and built by Wright Aeronautical Corporation, Paterson, N. J., this world-famous engine could supply light and power for an American village of more than 6000 inhabitants. Douglas Bombers, Martin Patrol Bombers, Curtiss-Wright Transports, Boeing Clippers are among the great airships using this super engine today.



Typical Bunting Bronze Bearings supplied to Wright Aeronautical Corporation.



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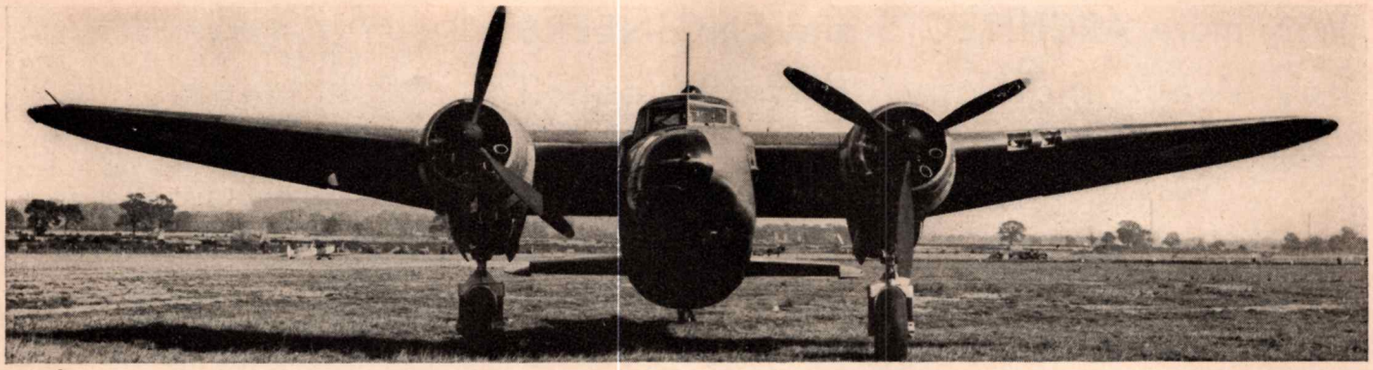


BLACKBURN "BOTHA" TORPEDO BOMBER

● Newest addition to the Fleet Air Arm, announced late in December, is the Blackburn *Botha* I, some details of which only recently were divulged by the Ministry of Aircraft Production.

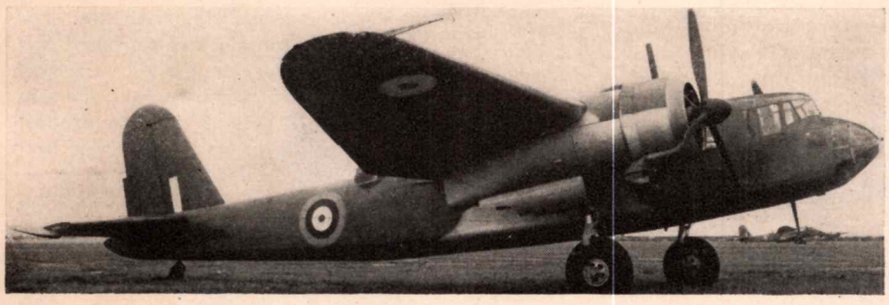
A twin-engined general reconnaissance and torpedo bomber, the *Botha* is a high-wing cantilever type powered by Bristol *Perseus* Mark XA sleeve-valve radial engines. It is of all-metal construction, has provision for a crew of 4, and incorporates many innovations learned as a result of war operations thus far.

Fuselage is a full monocoque structure having a series of transverse frames and longitudinal stringers to which the outer skin is flush-riveted. The cabin is arranged with the pilot in the forward section seated in the conventional position at the port side. To his right, on the starboard side is the navigator's station, this crew member also acting as bomber from a prone position enclosed in transparent sheeting. Aft, is the radio operator's station and the rear gunner's station. Intercommunication between the fore and aft sections is permitted by the installation of a gangway extending longitudinally along the starboard side. Entrance to all positions in the aircraft is through a large door on the starboard side of the fuselage.

Directly aft of the trailing edge of the wing, and in the aft portion of the cabin, is a power operated multi-gun turret, projecting over the fuselage. Other equipment in the aircraft includes a collapsible life-raft, markers, floats, *etc.*, in addition to a complete radio and electrical installations.

The wing having a span of 59 ft., consists of three sections—the center section which carries the engine nacelles, and two outer sections. The center section is parallel in plan, while the outer sections taper considerably towards the tips, which are rounded. The outer panels of the wing have a pronounced dihedral.

Balanced ailerons extend along a portion of the trailing edges of the outer sections, and flaps are along the trailing edges of the center section. The flaps are hydraulically operated and may be used to improve take-off.

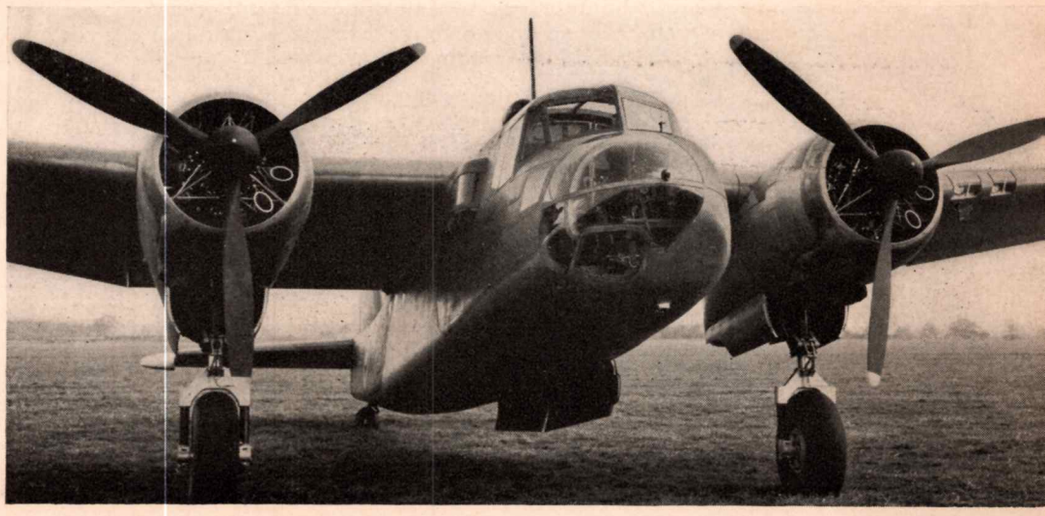


The center section carries the engine mountings and the landing gear units, and also houses the main fuel and oil tanks.

Tail section is a full cantilever design, utilizing stressed skin construction; movable surfaces are fabric covered, the fixed surfaces metal-covered. The stabilizer is placed to the rear of the vertical fin, its leading edges sweeping back slightly towards the tips, and the trailing edges of the elevators forming a straight line. The leading edge of the vertical fin slopes to the rear, while the trailing edge of the rudder is vertical. Tips of the stabilizer and rudder are well rounded. Rudder and elevators are balanced by a combination of inset hinge and horn balance, and trimming tabs are provided.

Landing gear consists of separate retractable oleo-pneumatic legs carried beneath the engine nacelles and retracting into them. When the wheels are raised hydraulically, mechanically operated doors close beneath the legs and give a smooth undersurface to the nacelles. Retraction is effected by hydraulic rams, nut cracker type rear struts being used; brakes are hydraulically operated.

(Continued on following page)



Views of the Blackburn "Botha" powered with Bristol "Perseus" engines

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17 Degrees—9H to 6B. Also 3 Degrees for Tracing and Direct Pencil Blueprints.

(*Continued from preceding page*)

The tail wheel is mounted on an oleo-pneumatic shock absorber strut, the wheel having castor action with friction dampers.

The engines are provided with leading edge exhaust collector rings and are enclosed in deep chord fairings with controllable cooling gills. Three-bladed, constant speed, controllable pitch propellers are used. The rear portions of the engine nacelles, which are detachable, are mounted below the center section, and house the retractable undercarriage units.

The Bristol *Perseus*, rated at 810 hp in 1936, was the first sleeve-valve engine to be used by the RAF—at first in Vickers *Vildebeeste* torpedo-bombers. In 1937, the *Perseus* went into quantity production—the first sleeve-valve aircraft engine in the world to earn this distinction. The fully supercharged version develops 880 hp at 15,000 ft., the moderately supercharged version 905 hp at 6,500 ft., the civil rated version 890 hp for take-off.

Showing its extreme reliability in the rigorous operations demanded of military aircraft, the sleeve-valved engines in RAF service have been giving an excellent account of themselves. Their leading characteristics are high specific output, low specific fuel consumption, low weight-power ratio and small bulk.

The single sleeve-valve mechanism is essentially simple in design and offers numerous practical advantages in operation—another important consideration in war operations. It eliminates valve maintenance routine and top overhauls, reduces fuel consumption, lessens both mechanical and exhaust noises, and minmizes fire risk because of lower exhaust-ring temperatures and more even head temperatures.

External appearance is clean and simple because of the absense of outside valve gear, and this is especially noticeable on the double row types. In view of the increased number of aircraft engines for which positive engine drives are required, installation and maintenance problems have been simplified by the provision of a remote-mounted gear box driven by the engine through an enclosed, flexibly-jointed shaft on some of the models.

Internal construction features the use of a train of spur gears driven by the crankshaft by which half-speed rotation is given to a series of small sleeve-valve operating cranks. These cranks have bearings in both crankcase and front cover, and the crankpins protrude inside the crankcase. Through a spherical and sliding coupling, each crankpin engages with a lug on its associate sleeve valve, the latter being a telescopic steel tube working between the piston and the cylinder.

NEW Equipment

Lightweight Relays For High Inrush Loads

Two new Dunco relays—light in weight and vibration-proof—have been designed primarily for aircraft service for control of flaps and such applications as lamps, motors or other devices where high inrush loads are likely to be encountered.

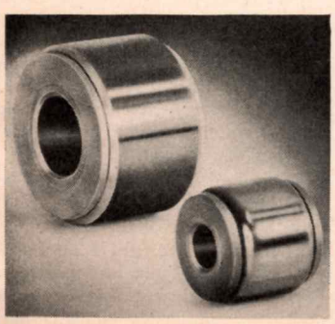
The standard Type C3007 relay is single pole, single throw with normally open non-welding contacts rated 50 amps. at 12 or 24 volts dc; it will stand an inrush of 100 amps. Contact pressure is 10 lbs. Coils are rated 8 watts continuous and are for operation only on dc; dimensions are $2\frac{3}{4}'' \times 1\frac{7}{8}'' \times 2''$, and the weight 8 oz.

Two Type CX3007 relays mounted on a common base for motor reversing are $3\frac{3}{8}'' \times 4'' \times 3''$, and the weight is 15 oz. A larger relay, CXA3008, is rated 100 amps. at 12 volts dc or 80 amps. at 24 volts dc and will stand an inrush of 300 amps. Coil is 10 watts continuous, contact pressure is 15 lbs., size $3\frac{3}{4}'' \times 2\frac{1}{2}'' \times 2\frac{3}{8}''$, and weight is 21 oz. Many modifications and adaptations of either unit can be supplied to meet individual requirements by Struthers Dunn, Inc., Philadelphia, the manufacturer.

New Needle Bearings For Aircraft Applications

A number of new needle bearing assemblies, specially intended for the requirements of aircraft service, were recently announced by The Torrington Co., Torrington, Conn. The bearings are made in two series—AR for normal service, and AT Series for heavy duty.

Bearings in both series are provided with inner races and permanently attached end washers. All exposed surfaces are cadmium plated.



Torrington needle bearings

Cold-Setting Resin Adhesive

A new synthetic resin adhesive for plywood manufacture and wood-parts assembly, which gives an extremely strong, waterproof and fungus-resistant bond without the use of hot presses or other special equipment, was recently announced by Resinous Products & Chemical Co., Philadelphia. Known as Uformite CB-550, the product is designed to extend the advantages of resin adhesives to fields where hot pressing or curing has been considered impractical.

Supplied as a dry, water-dispersible powder, this urea formaldehyde resin is mixed with water to paste consistency. It contains its own catalyst which causes the resin to react or set in 6 to 8 hours in the clamps at room temperature. Ordinary glue spreaders are used.

Uformite CB-550 is claimed to give bonds possessing water resistance far superior to that obtainable with animal and vegetable glues. The results of tests on 3-ply $\frac{3}{16}''$ birch panels immersed in water for 24 hours show that animal glue, vegetable glue, and casein bonds delaminate, whereas the Uformite CB-550 bond shows no evidence of delamination under identical conditions. Under breaking tests after immersion, the panels fractured at 300 lbs./in.^{2}

Process for Surface Hardening Stainless Steels

Parts made of standard stainless steel can now be surface hardened by a process developed and sponsored jointly by Drever Co. (Philadelphia), and Industrial Steels, Inc. (Cambridge, Mass.)

The new process makes possible the formation of a tightly adhering glass-hard (89-93 Rockwell 15N) abrasion resistant case, .002″ to .028″ thick on the surface of stainless steels, giving high wear resistant properties and practically the same corrosion resistance as the untreated material.

18-8 parts surface hardened by the process have shown "B plus" rating in the standard ASTM salt spray test. Samples of both chrome iron and chrome nickel-iron, after treating show "A" rating after test in gasoline, kerosene and fuel oil. High pressure saturated and superheated steam, impingement test on surface hardened 18-8 showed no case deterioration after 100 hrs.

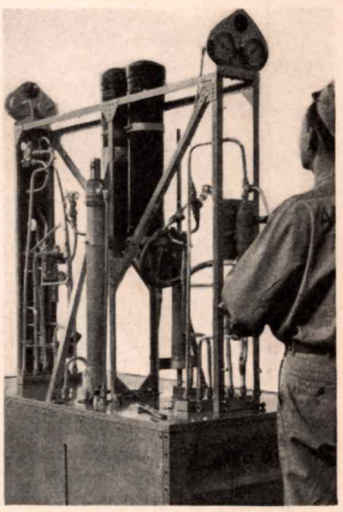
American Airlines Improves Test Stands

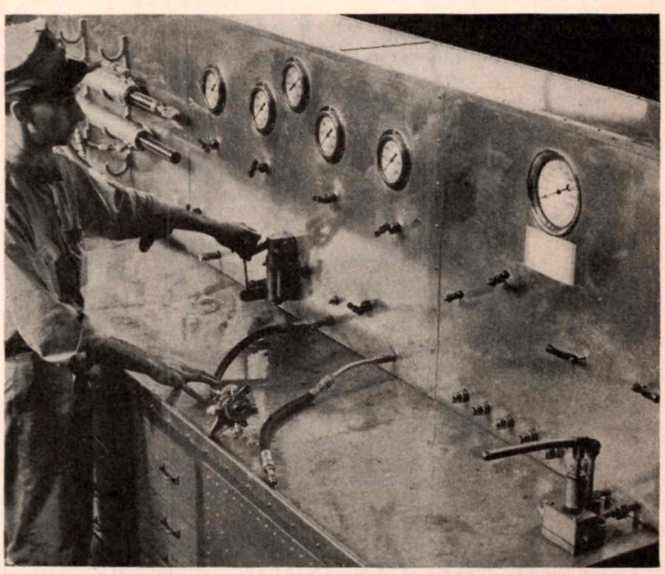
An elaborate improvement in stands for testing airplane hydraulic systems has been made recently by experiments in the manufacturing department of American Airlines, Inc.

One device—the panel test stand—takes the complete hydraulic system of a Flagship and tests it under simulated actual conditions of operation. This stand contains a 5 hp motor with speed changes from 1050 rpm to 3700 rpm.

Included on the stand is the complete panel unit from a plane, and the emergency hand-pump. There also is a landing gear retracting strut connected to the panel to simulate actual conditions while being tested, and a flap retracting strut.

An important feature of the engine-produced pressure for testing





At the bench test stand each individual part of the Flagship hydraulic system is tested before being returned to service. Here a 4-way valve is being tested at 1000 lbs./in.^{2} This testing bench is the only one of its kind, uses a 5-hp motor to build pressure. Old method hand pump (above) demonstrates method in common use

Rudy Van Devere built this storage rack to eliminate damage to parachutes resulting from careless handling on the ground

is the speed changes. This makes possible rapid testing at different pressures with cutout switches operated electrically.

Extensive use of engine speed changes is made in a unique bench test stand.

Here the individual valves, struts and many parts of the hydraulic system are tested at the various pressures under which they operate. A selector valve quickly selects the pressure desired for the individual part.

This is essential because brakes operate at 600 lbs. pressure, windshield wiper at 300, the regulator at 800, *etc.*

The test stands are a decided improvement over the hand-pump operated pressure system formerly used.

Storage Rack for Handling And Protecting Parachutes

Damage to parachutes resulting from careless handling has been minimized by the use of a new device originated by Rudy Van Devere, manager of the Akron Airways, Inc.

Prompted by watching student pilots who are engaged in the present training program at the Akron Municipal Airport, Van Devere sought a device which would make proper handling of 'chutes easier than throwing them on the ground. He designed a 3-shelf storage rack, mounted the cabinet with swivel forks, on four General Jumbo Junior pneumatic tires so it can be rolled in and out of the hangar with ease.

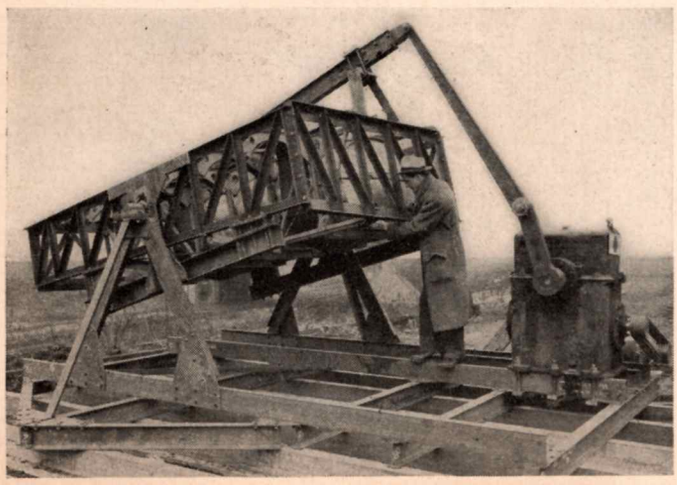
The rack rolls smoothly up to each plane, ready for training flight, making the student's parachute handy and clean. Students willingly return the 'chutes to the rack shelves for storage when not in use. Great advantage of the movable rack is convenient placement in the hangar, and the ease of rolling it alongside the hangar heating equipment in damp weather to keep the parachutes dry.

Rocker Tests Self-Sealing Fuel Tanks for Aircraft

A ponderous device that simulates by a rocking action some of the stresses and strains imposed on an aircraft fuel tank in flight, has been developed by The B. F. Goodrich Co. to test the firm's self-sealing fuel tank.

Called a "slosh tester," the device rocks the fuel tank in 16 to 18 cycles a minute to measure the effect on the tank of the force of the sloshing fuel.

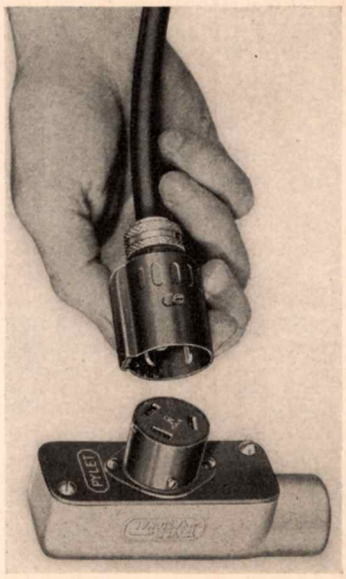
The accompanying illustration shows a Goodrich engineer examining a 425-gal. capacity fuel tank following a 25-hr. test. The self-sealing feature, which closes holes in the wake of high-powered and large caliber machine gun bullets, is imparted by a special lining.



Goodrich tests self-sealing fuel tanks in this "slosh-tester"

Pyle-National Plugs and Receptacles

Pyle-National Co., Chicago, has developed a new line of heavy duty plugs, receptacles and cord connectors for use with portable electrical equipment. While this line has the same electrical rating and is approximately the same size as standard attachment plugs and receptacles, it embodies the heavy duty design and substantial construction features of the larger Pyle-National *Triploc* plugs and receptacles for industrial use. Ratings are 10 amps., 250 volts; and 15 amps., 125 volts.



All 2, 3, and 4 pole contact units are interchangeable, to permit using a wide variety of plug shells and receptacle housings to make any desired assembly combination. Contact units are reversible, for safety protection. The enclosed female contacts may be assembled in either plug shell or receptacle housing, depending upon which is connected to the live line side of the circuit. This allows the use of extension cords with cable connectors, and convenient receptacles mounted on portable equipment, without the hazard of exposed live contacts.

Contact units are molded bakelite with renewable self-aligning flat bronze contacts and side-wired binding screw terminals. Plugs cannot be inserted incorrectly, nor can they be inserted in any receptacle having a different number of poles, nor in conventional wall outlet receptacles. Polarity is maintained by unequal spacing of the contacts and a keyway in the contact unit insulation.

Three and four pole contact units can be furnished with one pole grounded for installations requiring an equipment ground wire. Grounded contacts are extra long to insure making contact first and breaking contact last.

Plug shells extend beyond the length of the contacts as a protection against damage. An automatic bayonet lock which engages a lock post on the receptacle housing is provided. The lock engages without twisting or turning the plug, and the sleeve does not rotate in the hand when the plug is inserted in the receptacle. A definite manual release is required; the plug shell must be turned slightly to the left to disengage the lock.

Spartan students study the new navigational teaching device

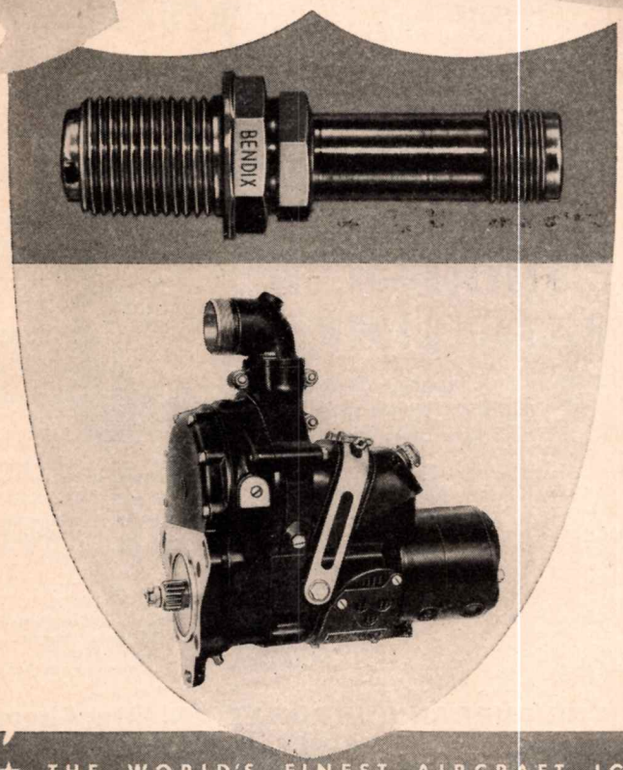
Spartan Instructor Designs Navigation Teaching Aid

A mock-up fuselage used in training flight students of the Spartan School of Aeronautics in the use of navigation equipment and radio direction apparatus has been designed by Warren C. Youngclaus, chief instructor of the navigation department.

The built-up all-metal fuselage of the pilots' compartment, made by the students of the sheet metal department, is mounted on swivel rollers which enables movement in all directions. It is equipped with navigation instruments, and

(Continued on following page)

"Up there" with American Aviation



YESTERDAY, TODAY and TOMORROW

The future of that close partnership of Bendix-Scintilla and American Aviation is bright. For it is built on the sound basis of mutual confidence and assistance.

Bendix-Scintilla Magnetos and Spark Plugs have lived up to every trust placed in them. And this year-after-year confidence of American aviation in those products is a constant inspiration for Bendix-Scintilla to go steadily forward with improvements. You can count on Bendix-Scintilla products being "up there" tomorrow just as they were yesterday and are today.

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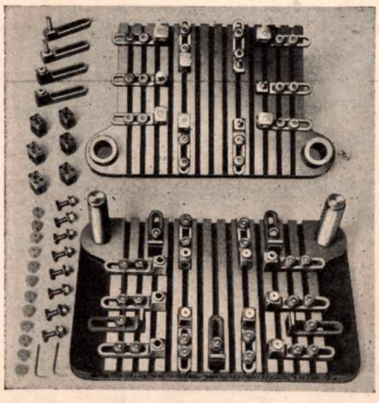

★ Whistler adjustable dies permit minimum perforating centers of ⅞".
★ Dies for perforating holes from 1/32" to 1½" in mild sheet steel to ⅛" thickness shipped from stock. Larger sizes on order.
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★ Operating satisfaction assured.
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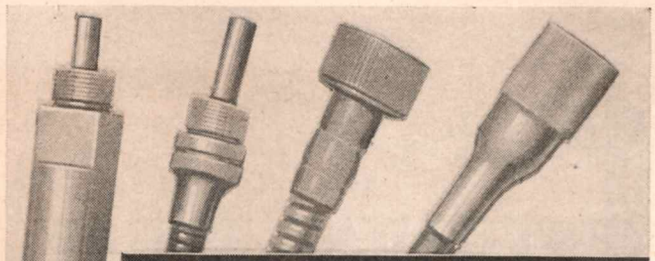
WHISTLER ADJUSTABLE PERFORATING DIES



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Pistons illustrated . . . Lycoming "80" . . . approximately 400 hours.

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GENERAL AIRCRAFT SUPPLY CO.
City Airport, Detroit, Mich.

FLEET AIRCRAFT, LTD.
Fort Erie, Ontario, Canada

(Continued from preceding page) there is a drift indicator on the floor. A chalk line drawn on the floor serves as the reference point for taking drift sights, so that when the compartment is moved across the floor, it can be shifted into various positions, thus enabling a drift reading to be made.

Other instruments include an air speed indicator, altimeter, and a magnetic compass which, besides showing the process of compass course flying also serves as an aid to manually display steps in compass compensation.

There is also a rotating loop antenna, which when rotated, actuates a rheostat controlling an electrically operated oscillator.

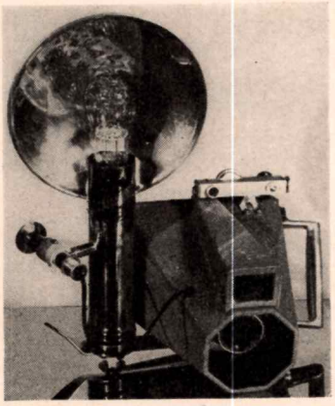
When the loop is turned about 45° from the heading of the fuselage, a signal fadeout is obtained from the oscillator and this, in conjunction with the magnetic compass, gives the relative bearing of the radio station. A small bearing plate and indicator is attached to the loop for directive indicating purposes.

The oscillator can also be used for homing instruction as well as radio-range flying, as the rheostat enables the signals to be increased and decreased at will. A telegraph key is used to give the identifying signals.

Skyview Produces New Aerial Camera

Designed to fill a need in camera equipment for airport operators, pilots and plane owners, the new *Sport-Air* camera produced by Skyview Camera Co., Olmstead Falls, Ohio, is a basic aerial camera, equally well adapted for all types of ground photography, indoors or outdoors.

Ready for air use, the camera weighs 3¾ lbs. It has an overall



length of 7½″; a fully corrected, f4.5 anastigmat lens in focusing mount, working from 4 ft. to infinity; and a rim set shutter operating from 1/10 to 1/200 sec., bulb and time exposures.

There is a brilliant, direct view finder giving large upright image, filter, range finder, photo electric exposure meter, and flash synchronizer.

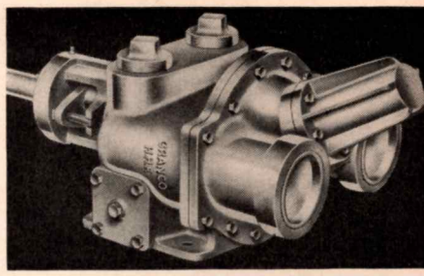
High-Speed Refueling Pump

To meet the needs of high-speed refueling of airplanes, and also for rapid handling of such materials as high octane gasoline, paints, oils, light solvents, inks and other materials, Granberg Equipment, Inc., Oakland, Calif., developed the Model HHF Transport pump, which is designed to produce from 50 gpm at 100 rpm to 200 gpm at 400 rpm.

Two suction and two discharge ports are provided, the former being 3″ in dia., the latter 2½″. Suction parts are arranged horizontally; discharge ports vertically. Either one of each pair may be used, according to the direction of rotation of the pump.

The pump weighs 150 lbs., is 11″ wide, 10⅞″ high, overall. A chatter-proof relief valve is built-in, submerged, and readily adjustable from outside. The outboard ball bearing is integral with the pump, insuring permanent shaft alignment.

Discharge is smooth and even, and the pump is self-priming. Turbulence is reduced to a minimum. The pump has no gears, washers, blades, scoops, cams, valves or dragging or sliding motions—the rotor is pivoted in the housing, does not touch it, thus minimizing friction. As in all Granco pumps, the fluent is moved by a natural squeezing action.



Granberg high-speed refueling pump

Cleaner for Aircraft Interiors

New ease and added safety in cleaning interiors of aircraft is now possible with the recently developed Sparton Vibromatic Cleaner manufactured by Sparks-Withington Co., Jackson, Mich.

Before the use of cleaning machines in the ships and hangars was discouraged because of the danger of sparks from electric motors coming in contact with gasoline fumes. The new cleaner, operating by compressed air pressure, not only eliminates this danger, but transforms the steady air pressure into a beating, pulsating vibration, breaking up and removing all dirt, sand and dust from floors, upholstery and decorations. It can be operated from any standard air outlet.

It is provided with cloth receiving bag, extension tubing, high-pressure hose and attachment for removing water and cleaning fluids.

MACHINES TOOLS SHOP EQUIPMENT

Tool Room Precision Lathe Designed for Small Work

The new Model A 9″ swing tool room precision lathe recently announced by South Bend Lathe Works, South Bend, Ind., is adaptable for small diameter work requiring a high degree of accuracy and sensitivity. This lathe has a maximum collet capacity of ½″, maximum swing over bed ways of 9⅛″, and a maximum swing over saddle cross slide of 5½″. Three bed lengths are available, providing center distances of 16″, 22″ and 28″ respectively.

Twelve spindle speeds ranging from 41 to 1270 rpm are provided on the motor drive models. Smooth operation at high speeds is attained by using a direct belt drive to the spindle for speeds above 400 rpm. A wrenchless bull gear lock permits engaging the back gears quickly when slow speeds are required for machining large diameters.

A series of 48 power longitudinal feeds, 48 power cross feeds and 48 pitches of screw threads, right or left hand, are provided by the quick change gear mechanism. The full automatic apron is equipped with a powerful worm drive and friction clutch for operating both the automatic power cross feeds and the automatic power longitudinal feeds. An automatic safety interlock makes it impossible to engage the half nuts when the power carriage feeds are in use.

This lathe is made in floor type with pedestal motor drive, in bench type with motor drive, and in both bench and floor types with countershaft drive.

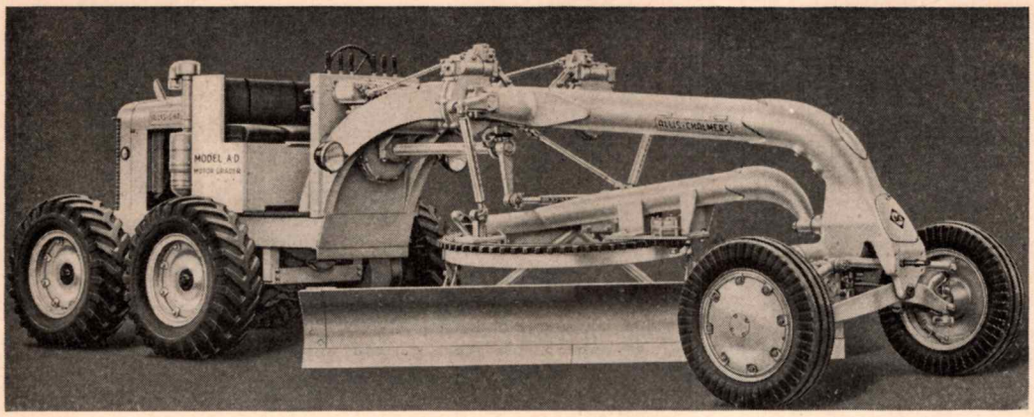
Portable Drafto Drawing Machines

A line of portable drawing machines which can accommodate paper sizes from 9″ × 12″ to 18″ × 24″ was announced recently by The Drafto Co., Cochranton, Pa. All models are mounted on Masonite board with parallel arms and stainless steel protractor plate.

Models 10 and 15 take paper sizes 9″ × 12″ and 10″ × 15″. These feature one-piece scales permanently attached to the protractor plate. The protractor is graduated in 2°, and a clamping device provides equal locking tension at all angles to prevent slippage.

Models 30 and 35 take drawings to 12″ × 18″ and 18″ × 24″. Equipment on these models includes a vernier-controlled protractor giving readings to ½°, and detachable scales which can be easily removed or inserted. Also for speed and convenience, a latching device is provided which locks the scales at 0°, 30°, 45°, 60° and 90° reading on either side of the 0° reading.

All models use chromium steel, bright finished in the parallel arm assembly, and dull finished on the protractor device. Assembly is complete with clips along the top edge to hold drawing paper and tracings.



Allis-Chalmers new Model AD motor grader into which has been designed greater power and earth moving capacity than other devices of a similar nature

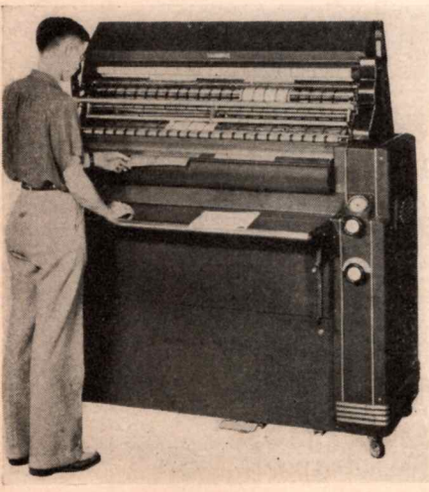
Allis-Chalmers Heavy-Duty Motor Grader

A piece of equipment which should find extensive use in airport construction and maintenance was announced recently by Allis-Chalmers Manufacturing Co. Known as Model AD motor grader, it weighs 21,500 lbs., and is said to have more power and earth-moving capacity than any other motor grader. It is especially designed for heavy grading, bank cutting, ditching (both forward and reverse), oil mixing and snow removal.

Greater earth-moving capacity is attained through more clearance under the front axle and circle permitting the full volume of dirt to roll off the blade without hanging up in the axle or circle thus absorbing engine horsepower, decreasing travel speeds and increasing fuel consumption. The *Hi-arch* front axle has 22″ of clearance and there is 6¾″ of clearance between the *Roll-away* blade and the circle.

Power is supplied by a GM 2-cycle Diesel engine developing 75 bhp. The transmission features short, heavy shafts and carburized and hardened gears. Speed range is 6 forward and 3 reverse, with throttle control forward speeds from 1.48 to 16.6 mph and reverse speeds from 1.75 to 6.15 mph. Two-speed mechanical controls are employed with a low speed set for close adjustments and a high speed set for fast movement.

Frame is of 10″ tubing and heavy box section girders. Lift cases are mounted directly over the circle for rigid control of the full revolving blade which has a bank cutting angle of 90° and a 5′ 7.5″ reach outside the front wheels. The tandem drive assembly is supported on a 4½″ main drive shaft and is chain driven.



Bruning's new high speed developer

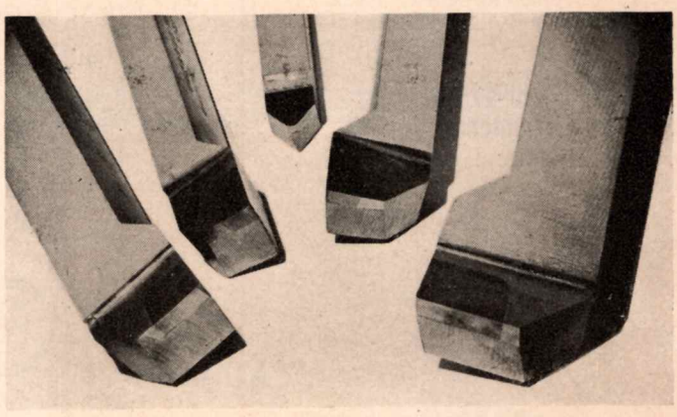
Carboloy Expands Standard Tool Line

The addition of five new styles to its line of standard tools was announced last month by Carboloy Co., Inc. Available in a total of 21 sizes, the new standard tools comprise four "offset" types and a two-way square-shank turning style—each type except the last being available in two grades—one for steel cutting and one for cast iron, *etc.*

Of the new tools, the two-way turning tools (Style No. 12) have tips of 883 Carboloy and are available in 5 sizes, ranging from 5/16 to ¾ inch square shanks for machining of cast iron, non-ferrous metals, *etc.*

The various offset tools are designated as styles No. 5, 9, 10, and 11. Of these, 5 and 9 are respectively right and left hand turning tools, while 10 and 11 are right and left hand facing tools. All are available in the following shank sizes: ¾ by 1; 1¼ square; ⅝ by 1¼; 1 by 1¼ inches. Chip breakers are provided on styles 5 and 9 for steel cutting, but not on styles 10 and 11, since the shape of chip breakers on these tools is largely dependent on the use to which they are to be put.

For general purpose machining of cast iron, non-ferrous metals, *etc.*, these offset tools are stocked in grade 883 Carboloy for the ¾ by 1 size, and in grade No. 44A for the remaining sizes—used for heavier cuts. For special requirements, the ¾ by 1 inch tools are also available at standard tool prices with tips of 44A while the 1¼ square, ⅝ by 1¼ and 1 by 1¼ are also available with tips of "883" at no increase in prices. Tools so tipped, however, are not stocked but are available on special order.



Five new styles of Carboloy tools, available in 21 sizes

Bruning High Speed Developer

A new high-speed BW developing machine has been announced by Charles Bruning Co., Inc., New York. Known as the No. 159 Volumatic Developer, the machine is designed to be used with the Model 75 BW Printer, giving a combination in which one operator performs the entire printing and developing operation easily and speedily.

In operating the Volumatic sheet developer, the sensitized paper and tracings are fed into the machine at the front, where they are immediately exposed in the printer section. A vacuum separator roll at the discharge point of the printer separates the tracings from the exposed prints, allowing the prints to pass automatically to the developing and drying sections. The tracing is returned to the operator, while the completely developed print is delivered flat and dry at the rear of the machine.

The developer consists of a separator roll, water roll, and a series of bands which carry the developed prints through the drying section.

The developing section is driven by the printer, and is synchronized to operate at exactly the same printing speeds. The 75 Printer has a speed range of 0 to 25 feet per minute.

Air-Cooled Welding Torch Nozzle Developed

Overheating of welding torch nozzles has caused production problems among operators working on light gauge metals in confined areas, or on heavy castings or metal thicknesses.

To overcome these difficulties Victor Equipment Co., San Francisco, has developed the *Airadiator*, an air-cooled welding torch nozzle with a radiator-like section made out of aluminum and provided with disc-like fins intended to maintain the desired flame characteristics of the torch.

The large cooling area provided by the fins keeps the tubular section cooler than the ignition temperature of the fuel gas and thus eliminates pre-ignition and resulting popping or backfiring. The torch handle is kept comfortably cool, an additional advantage particularly in the small types of aircraft welding torches.

(Continued on following page)

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TESTS ALL PROPELLER GOVERNORS *made today*

The Airaco Propeller Governor Test Unit is the only one that will test, calibrate and adjust all types of propeller governors made today. It enables the operator to perform all necessary test functions as recommended by the manufacturers of both Hamilton Standard and Curtiss Electric propeller governors. Write for engineering data sheets giving full particulars.

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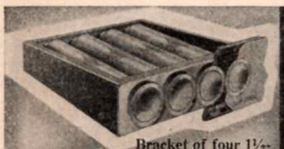
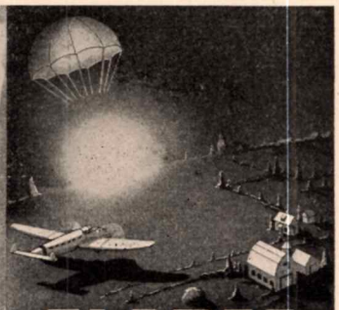


Bracket of four 1½-Minute (electrically operated) Parachute Flares, each of which will develop more than 110,000 candlepower.

3-Minute (electrically operated) Parachute Flare affording more than 250,000 candlepower.

1-Minute (pistol operated) Parachute Flare, expendable barrel type. Pistol can be used for discharging various kinds of Signals.

These are a few of the many types of Flare and Signal equipment pioneered and manufactured by "INTERNATIONAL".



FLARES

Specify "INTERNATIONAL" for Safety and Dependability

Years of specialized development and production of Flare and Signal equipment for the U. S. War and Navy Departments and Coast Guard are assurance of maximum value in dependable performance, safety of operation and effective service life.

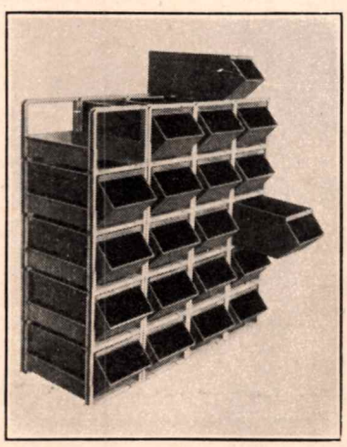
"INTERNATIONAL" has the only complete line of Landing Flares approved by the U. S. Civil Aeronautics Authority to meet their full range of weight classification requirements. The C. A. A. uses "INTERNATIONAL" Flares on its own planes.

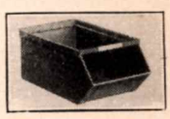
"INTERNATIONAL" also makes many special types of pyrotechnics to specification for military and commercial aviation, both domestic and foreign.

INTERNATIONAL FLARE-SIGNAL DIV.
of THE KILGORE MFG. CO. Tipp City, Ohio

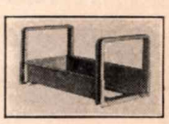
A Storage Unit that REDUCES HANDLING of Parts and Materials

Because Stackbins are portable containers — not fixtures — parts and materials can be carried to departments, from machine to machine, or held in stockrooms without being transferred from one container to another. Stored in Staekracks, any Stackbin is instantly accessible when its contents are needed — without disturbing any other bin.





STACKBINS are individual hopper-fronted stacking bins, designed for storage, transportation and assembly.



STACKRACKS are individual units which lock together to form storage racks of any size, shape or capacity, into which Staekbins slide like drawers.

STACKBINS in STACKRACKS offer a storage system that reduces handling, saves valuable space, and speeds work. Write us for complete details and low prices.

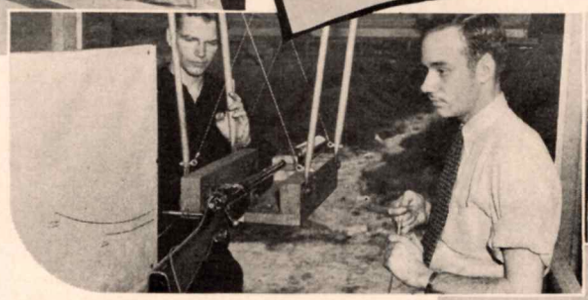
STACKBIN CORPORATION
79 Troy Street Providence, R. I.
"Stacked and Still Accessible"

AERO ITI

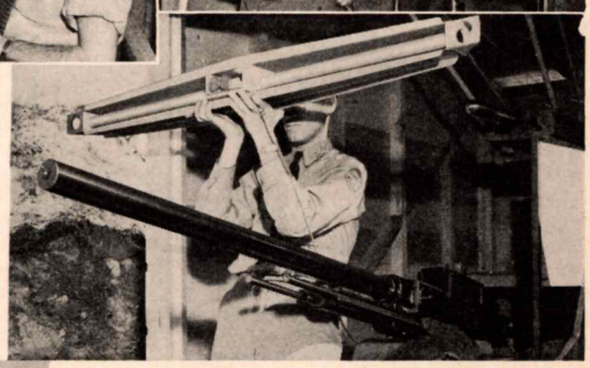
Meeting the Vital Need for Engineers Trained In *Armament Design*

ABOVE: An armament design group in the engineering department of Aero Industries Technical Institute.

RIGHT: Testing muzzle attachment on a ballistic pendulum for recoil force comparison. The arcs described on the board at left indicate that the muzzle stabilizer has reduced the recoil forces approximately 50 per cent.



LEFT: Student visually checking effectiveness of flame and smoke arrestor



Instruction and practice in armament design and engineering is an integral part of the thorough training in aeronautical engineering given by Aero ITI. Qualified students desiring to specialize in armaments are given unlimited opportunity for advanced study, research, and development work. This is believed to be the only training of its kind offered by any educational institution, public or private. It is given to help meet the present and growing need for armament-minded engineers.

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Student studying the technique of setting gun elevation by means of range finder. The Aero ITI armament division has its own firing range and gun house on the school campus.

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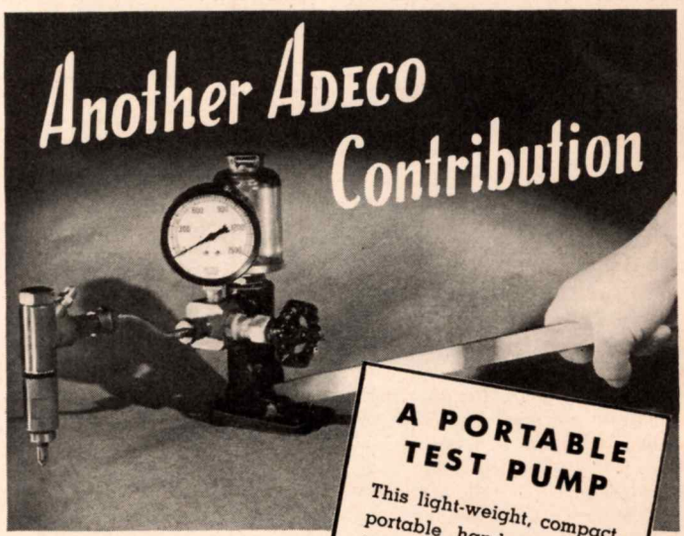

A PORTABLE TEST PUMP

This light-weight, compact, portable hand test pump is all you need now to test all types and sizes of fuel injectors right on the spot — quickly, accurately and without removing injectors from the engine block.

- **Stands only 9" high. Base is 4¾" by 2½". Weight, 6 lbs.**
- **Avoids costly delays and possible damage to injector tips.**
- **Precision-built to insure absolute accuracy.**
- **Makes testing a simple, routine job anywhere.**

Write for full information.

ADECO

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(Continued from preceding page)

Vacuum Type, High Speed Printing Machine

A large capacity, vacuum type high-speed printer just developed by Newton Machine Works, in Newton, N. J., is expected to provide the operator with high speed output of prints up to 30″ × 40″, and convenience and accuracy in production.

Equipped with an automatic electric timer, and a ⅕ hp vacuum pump, the machine also has a folding instrument board which concentrates all controls for the operator at one convenient location so that he may operate the vacuum pump gauge and vacuum pump switch with ease and speed. This switch, when thrown in the "off" position, automatically releases the air.

There are two sets of lights—white lights for making positive prints, and yellow lights for printing *Reflex* negatives. These lights are operated by appropriately marked switches and the automatic timer may be set for any predetermined exposure of seconds. Where longer exposures are desired, the auxiliary manual control may be used.

Constructed in two sections, the machine permits easy handling from one part of a plant to another.

Mounting for Motorizing Machine Tools

Multi Motor Mounting which provides for individual motor installation on all types of used machine tools was announced last month by Western Manufacturing Co., Detroit.

It accommodates all *Nema* frames No. 204 to 326 (1-15 hp at 1800 rpm), including practically all Canadian, British, South American and overseas motors, together with older and special motors up to 10 hp used in the U. S. No extra plates or rails are necessary. Motor installation time is reduced to a minimum and provision has been made for the take-up of V-belts between motor and transmission.

Three models are available—(1) the lathe mounting bracket, for motorizing automatics, bolt cutters, Fellows gear shapers, vertical milling machines, radial drills, turret lathes, screw machines, *etc.*; (2)—the standard shaper bracket for shapers requiring up to 10 hp motors. This bracket is also adaptable to boring mills, vertical mills, slotters, *etc.*; and (3)—the milling machine bracket, which comes in two sizes—7″ and 9″. The 7″ bracket is suitable for the majority of No. 1 and No. 2 mills and a few of the No. 3 sizes. The 9″ accommodates sizes of No. 3 and up to capacity.

Tool Room Machine With Thread Cutting Lathe

Hannifin's new No. 10 tool room machine is a general purpose unit combining the usefulness of the precision lathe, sensitive drill press, horizontal milling machine, and vertical milling machine. In this model the lathe is a precision thread cutting tool with power longitudinal feed of the compound slide.

The semi-steel lathe bed is of special rectangular section, mounted on a heavy base. The compound slide has power longitudinal feed, with a quick change gear box giving 45 thread pitches from 4 to 120, and 63 feed changes from .250 to .0021. An interlock between the lead screw clamp nut and the compound slide lock prevents engaging both at the same time. The compound slide has rapid adjustment clamping features, and ground adjustable take-up gibs. The tool post rest is graduated, allowing accurate settings 60° either side of center. Feed screw handles have adjustable micrometer dials of large diameter.

The lathe is driven by a reversible 1 hp 1725 rpm motor, giving 12 spindle speeds, 85 to 1250 rpm. The lathe spindle is mounted in pre-loaded ball bearings, and formed to take adapters having B & S No. 10 taper shank. The lathe spindle has a key drive nose for positive driving of attachments.

Maximum swing is 9 in.; length of bed, 30 in.; between centers, 18 in. Spindle taper adapter provides taper bore for a center, male thread for adapting chuck, face plate, or other fixtures, or collet holder with closing nut for collets of ¾″ maximum capacity.

Ignitron Spot Welding Rectifier Operates 2 Welders

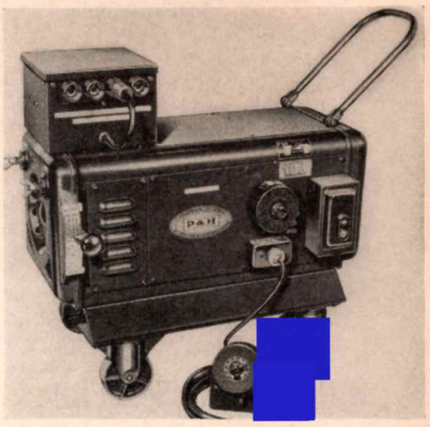
Designed especially for supplying required dc current to magnetic energy-storage type spot welders, a new ignitron spot welding rectifier has been developed by Westinghouse. The new rectifiers are available for use with 40 kw or 120 kw spot welders. Each rectifier will operate two welders if they are sequenced so that only one can be loaded onto the rectifier at a time.

The rectifier consists of a control and protective panel, power transformer and ignitron power tubes all contained in a forced ventilated floor-mounted sheet metal cabinet with a heavy welded base frame. Tubes are arranged for water cooling, the cooling being controlled by a thermostatic water flow switch. The control and protective panel is located in the top of the cabinet and the ignitron assembly in the bottom. Hinged doors provide access to the front of the cabinet and the back is removable for maintenance. A 14 in. fan, driven by a ⅛ hp motor cools the transformer, exhausting through a grill at the rear of the cabinet.

Harnischfeger Aircraft Welder

Just added to the complete line of welding equipment produced by Harnischfeger Corp., Milwaukee, the P&H-Hansen *Hot Start* welder is especially designed for aircraft use. Simple and compact in design, it has a welding range of 260 down to 10 amps.

This welder is intended to meet such production requirements as high open circuit voltage, smooth, fast, and more stable arc; and single control with an infinite number of current settings over the entire welding range. The machine is built for light gauge, medium, or heavy duty work.



P & H Hansen Hot Start welder

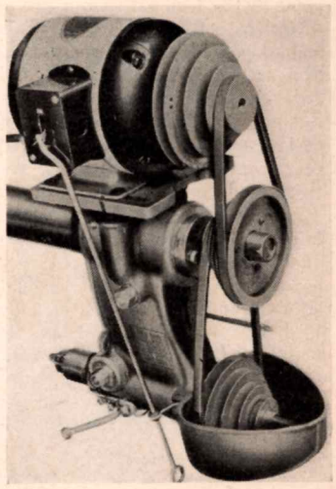
Attachments for Machine Tools

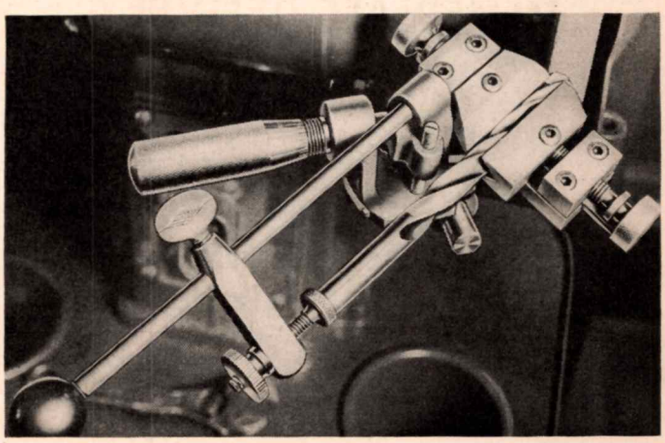
Delta Mfg. Co., Milwaukee, has just developed two new machine attachments which should be of interest to production men and plant superintendents.

One of these devices is for 14″ drill presses and provides a range of 12 speeds for both low or high speed drill presses, making it possible to use a standard 1725 rpm motor, where a special high speed or slow speed motor would ordinarily be required. This attachment consists of a heavy casting which mounts in the drill press column together with a cone pulley and two belts. Belt slack is taken up turning the casting so proper tension is always assured.

The multi-speed unit is quickly removed and easily adjusted. A grease-sealed ball bearing pulley is used in the assembly and insures smooth, even, vibrationless running.

The other unit is a drill grinding attachment which uses the face of the wheel for drill sharpening. A setting attachment with an





Delta machine tool attachments: (above) multi-speed unit for 14″ drill presses; (below) drill grinding attachment for drill sharpening

accurate scale permits micrometer settings that insure evenly ground lips so that the drills run true. The amount of lip clearance on the drill is just right with enough of the heel cut away to provide enough clearance without weakening the cutting edge.

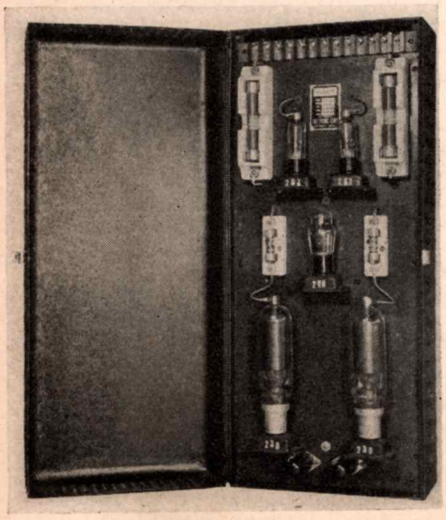
An additional feature of this new drill grinding attachment is that it can be adjusted so that each drill can be ground to fit the job with lip clearance and angles at any degree required. Its capacity is: 1/8" to 5/8" drills.

Independent Speed Rate Adjustment On New Miller

Kent-Owens Machine Co., Toledo, has announced its No. 2-20 hydraulic feed-to-table milling machine which has a table 42" long by 12" wide with 20" travel, and a fully automatic cycle. Table surface to spindle center is 13" max., and 4" min. The table can be fed or rapid traversed in either direction, automatically shifted from rapid traverse to feed in either direction, and automatically reversed at both ends of the stroke. It may be automatically stopped at any desired point in its travel.

Featured is independent adjustment of the feed rate for opposite directions of table travel. This makes possible doing one operation at one end of the table and an entirely different operation at the other end. Each direction of table travel has a separate feed rate control dial which is adjusted independently of the other. Thus, for example, the feed to the left can be set at 4" per minute and that to the right at 10" per minute. Similarly, this independent adjustment permits setting the feed rate exactly the same for both directions of table travel.

Any one of three spindle speed ranges in 13.35:1 ratio can be furnished, a medium range of 64-860 rpm being standard; other special ranges are 32-428 rpm or 96-1284 rpm. Wide face, quiet running pick-off gears are spline mounted and are easily removed for making spindle speed changes.

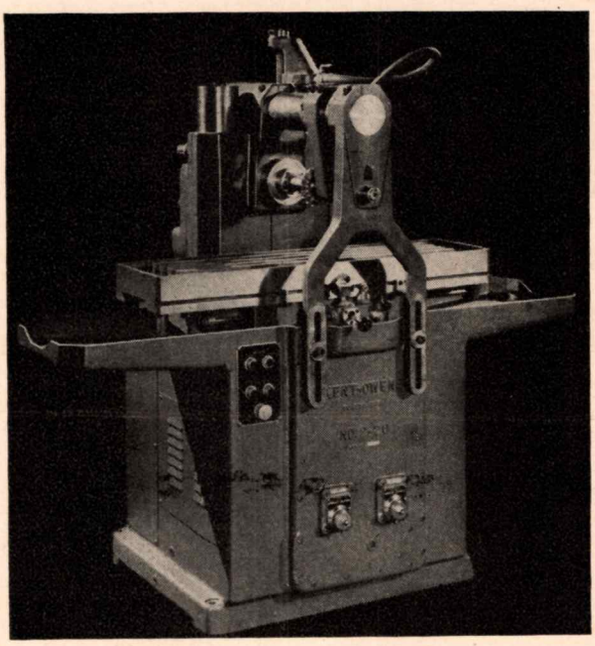


New Weltronic synchronizer

Riser Cutting Apparatus Announced by Airco

In response to demands for greater convenience in removing riser heads from metal castings, Air Reduction has just produced a new line of hand cutting apparatus consisting of two torches and three tips.

The torches, Styles 3180 and 9080, are of the straight head type, employing monel metal heads and stainless steel tubes. Each is 21" long. Cutting oxygen can be controlled by either a lever or trigger, and the type selected can be placed on top, on either side, or on the bottom of the torch to suit the convenience and comfort of the individual operator.



42" table Kent-Owens No. 2-20 hydraulic milling machine

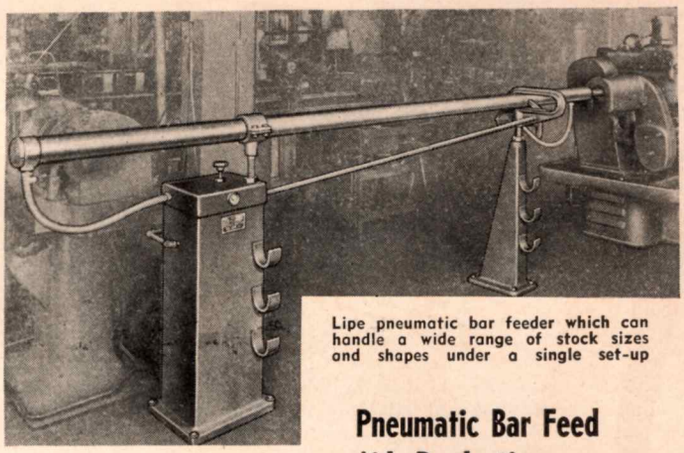
The new cutting tips are known as Style 187 bent to 75°; Style 181 bent to 90°; and Style 191 which is a 7" straight tip. All are designed with a short length from the end of the tip to the bend to permit greater maneuverability in the restricted areas and cramped quarters frequently encountered in riser cutting.

Electronic Synchronizer For Resistance Welding

Weltronic Corp., Detroit, have just announced the development of the Weltronic Synchronizer, designed to be used with any non-synchronous timer and power tube contactor to obtain synchronous operation, which is, starting the flow of electricity (current) at the zero point on the current wave, provided the wave form is approximately sinusoidal in character.

This eliminates the presence of transient currents and the resulting stresses and strains caused by these transients in welding transformers, making for longer transformer life and in some instances allowing the use of smaller size transformers.

The device is enclosed in a dustproof steel cabinet approximately 30" high by 12" wide by 12" thick, for wall mounting and is easily wired to any existing non-synchronous timer. Since it eliminates the firing relay usually supplied with power tube contactors, it provides for absolute accuracy in timing, even at extremely high rates of operation. There is an adjustment for any value of power factor encountered in welding transformers.



Lipe pneumatic bar feeder which can handle a wide range of stock sizes and shapes under a single set-up

Pneumatic Bar Feed Aids Production

The Lipe pneumatic bar feed unit is a self-contained automatic power stock feed device used in connection with machine tools having fixed stops for determining length of work.

It eliminates the need for feed fingers, collars, chucks, ratchets, rollers, wobble-plates on screw machines, turret lathes, cut-off machines, *etc.*

It feeds any distance without surface contact, will not scratch or mar the material, and holds the stock firmly against stop until the collet is closed.

Without setup change it will handle all sizes and shapes within the capacity of the machine tool with which it is used.

Construction and Operation

The unit, manufactured by W. C. Lipe, Inc., Syracuse, consists of an air cylinder sufficiently long to contain a full length stock bar, open at the forward end, adjustably mounted on two fabricated steel standards. Within the cylinder is a piston having a ball bearing cup center which supports the free end of the stock.

Air is supplied to the cylinder at low pressure, and forces the piston forward against the end of the stock, thus causing piston and stock to move forward rapidly and instantly when the collet is opened.

When the piston reaches the forward end of the cylinder the air pressure is automatically shut off and forward motion of the stock ceases. When the unit is reloaded, the new stock pushes the remaining short length until it is completely used. A coupler tube which floats in the spindle bore of the machine tool, supports the forward end of the new stock in alignment with the short piece and guides it into the collet of the machine.

The bar feed is available in three models, each accommodating 12 ft. lengths of 1" dia. (Model 125), 2" dia. (Model 225), or 2.5" dia. (Model 300).

(Continued on following page)

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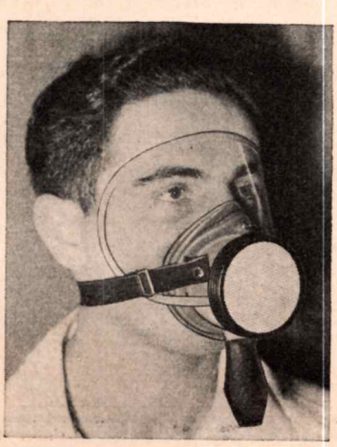
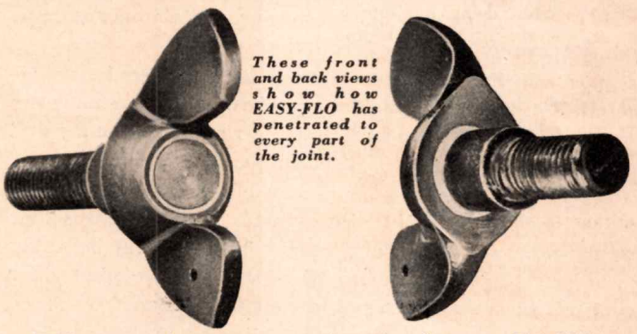


MANUFACTURING COSTS can be reduced with EASY-FLO BRAZING

For example — take this Clamp Screw

It is a simple part used on aviation ground equipment. It was formerly forged from one piece of steel and then threaded—a comparatively expensive construction, hard to handle for fast threading.

Now the wing nut is stamped out and the body is turned and threaded at high speed in a screw machine. The two parts, made of 1035 steel, are brazed in fast time with EASY-FLO. Over 200,000 of these screws have been produced in this way with substantial savings in time and big savings in material — and they have proved entirely satisfactory in service.



These front and back views show how EASY-FLO has penetrated to every part of the joint.

This complete penetration is due to EASY-FLO's exceptional free-flowing qualities and is an important reason why this alloy is known as the *fastest acting* of any brazing alloys capable of making strong joints. This extreme fluidity combined with low working temperature—1175 Deg. F.—gives a surprisingly low cost per joint.

APPROVED

EASY-FLO is included in Navy and Federal brazing specifications and used on a wide variety of government work.

If you are looking for brazing speed, reliability and economy, it will pay you to try EASY-FLO. It is equally effective on ferrous, non-ferrous and dissimilar metals. Bulletin AD-10 gives details—let us know if you want a field engineer to call.

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STANDARD FOR INDUSTRY

Once An Eagle—stricken by a dart . . .

***Said:**
"by our own feathers are we struck down!"

Old Libyan Fable

★ Most failures in airplane construction are "inside" jobs. Like the eagle viewing its own feather on the fatal dart, the pilot at the controls can better combat "outside" elements . . . when he can depend upon manufacturers and maintenance men for perfect groundwork.

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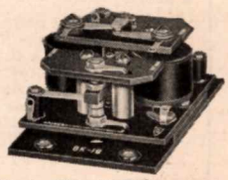
So light in weight—so utterly simple in design—so easy to mount and service—Relays by Guardian eliminate the usual heavy collection of large springs and levers so difficult to keep in order.

Specify Relays by Guardian to protect your instruments from sudden overloads. Improve automatic band switching of the radio aloft or aground. Control landing field lights with unfailing performance. Or, if you require a Complete Control Assembly—or a special control device—for commercial or military purposes, consult Guardian. Advice given without cost or obligation. Write



Series BK—16 Relay. Built to minimum tolerances and the most exacting requirements in production quantities for the U. S. Signal Corps.

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Pliers must — and do — figure largely in defense mobilization. And pliers must be efficient and well-made to conform to government specifications. Utica pliers and wrenches qualify and stand up under hard use and give dependable service. Made by specialists in the manufacture of pliers and wrenches, they are designed and built to give more tool hours.

UTICA DROP FORGE & TOOL CORPORATION
UTICA • N.Y.

(Continued from preceding page)

Stanley Electric Polishers

Stanley Electric Tool Div., New Britain, Conn., have developed two new polishers for cleaning and polishing metal, removing stains or heat tint caused by welding. They are slow speed (600 rpm) types for which proper brushes and compounds have been developed for maximum efficiency. Brushes have been developed by Osborn Mfg. Co., Cleveland, and compounds by The Pynosal Laboratories, Chicago.

The No. 2588-S-2, 8¼" in dia. and ½" wide, with a dense brushing face, is especially recommended. Up to four brushes can be mounted on arbors available with polishers. No. 182 Polisher is a two-purpose tool—it can be used as a polisher, or a drill chuck can be attached in place of the arbors to make a practical ½" drill. Arbors for two or four brushes and ½" Jacobs chuck are available. No. 187 Polisher has a straight handle and is used for polishing only. Arbors for two or four brushes are available. Both polishers are equipped with ac-dc universal motors for 110, 125, 150, 220, 230 or 250 volts.

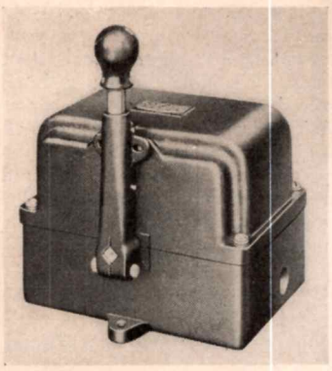
Variable Voltage AC Drive Permits Adjustable Speeds

Designed especially for industrial applications requiring smoothly adjustable speeds over wide ranges with constant torque, in locations where only ac supply is available, a new 10:1 adjustable-speed drive, which uses a series circuit without the usual exciter, was announced last month by Westinghouse. It is available in ratings from 1 to 15 hp with a standard speed range of from 175 to 1750 rpm, for 2- or 3-phase operation on 220-, 440-, 550-volts, 60-cycle systems.

The new drive has five parts, including control: There is a single-unit motor-generator set, consisting of a squirrel cage induction motor driving a series dc generator which supplies operating voltage for a dc series motor coupled to the driven load. In parallel with the generator series field is a rheostat which controls the driving motor speed. Control apparatus consists of an across-the-line starter for the squirrel-cage motor, and a pushbutton station.

The new drive is more flexible than the wound-rotor motor and is more efficient than the conventional variable-voltage system because it has no exciter rotational losses. High-torque characteristics of the dc series motor are combined with the flat-speed properties of the shunt motor to give good speed-torque characteristics.

Optional features include dynamic braking, and inching. Dynamic braking requires no external braking resistor, but employs a braking field wound into the motor. Horsepower ratings are based on top speed of 1750 rpm at 40°C. continuous operation. Open frames are standard; splashproof and totally-enclosed frames are available.



C-H cam-operated controller

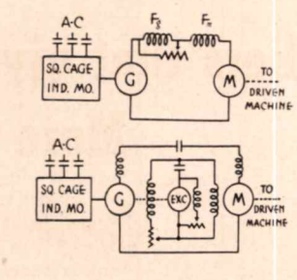
Cam Operated Controllers Speed Production

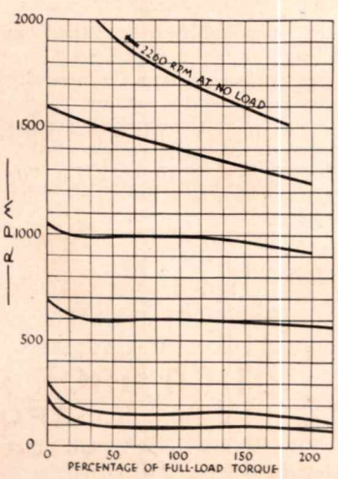
Speed up of production, through reduced fatigue, is claimed for the new line of Cutler-Hammer cam operated, mill duty controllers, which are reported to offer extreme ease of operation with positive feel of all speed positions by the use of an adjustable compression type of star wheel spring.

Available in two speed, three speed, and multi-speed types, the controllers are ideal for mill auxiliaries, crane hoist, bridge, and trolley applications.

Contacts are vertical, double break, silver to silver. The cam shaft operates on ball bearings sealed against dust, and easily accessible terminal board simplifies installation and service. A heavy cast case and cover, for either separate or bench board mounting, provide protection from dust and mechanical injury.

Optional features include: spring return; off position latch, two, three, or five speeds.





Circuit of new Westinghouse drive, and (below) its speed curve

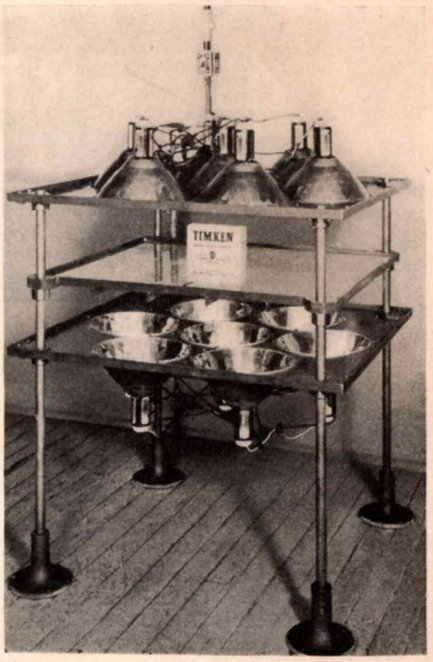
Electricity Gives Bearings Tight Press Fit

A novel method has been developed for heating bearing cones preparatory to assembling them on shafts where a tight press fit is required.

This device consists of three trays about 4′ square, approximately 12" above each other. The middle tray is of pyrex glass while the top and bottom trays each carry seven 250-watt special infrared ray bulbs. The reflectors on these special bulbs are gold-plated.

Bearing cones are not taken out of the boxes, but are stacked in their containers. About 20 minutes are required to heat a bearing to a maximum of 155°F. The infrared rays penetrate the boxes, heat the steel, but leave the cardboard relatively cold.

When this method of heating is used, it is not necessary to wash off the protective coating which is put on the bearings at the time of packing.



Set-up for heating Timken bearing cones

Non-Fogging, Light Weight Eyeshield for Welding

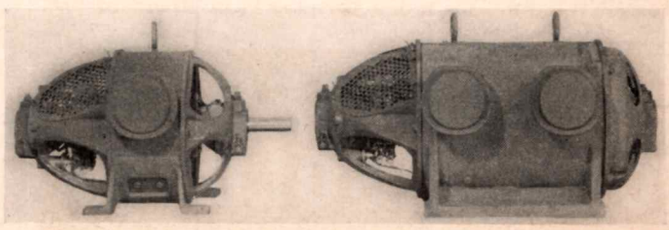
An improved eyeshield for use on gas welding, cutting and blow torch operations was announced recently by Jackson Products, Detroit, Mich. Designated Type BX, it is a cover-all shield which does not interfere with the wearing of prescription glasses. Enlarged opaque fiber side pieces afford greater protection. The light opaque frame fits snugly to forehead and cheeks, barring light and sparks.

The shield takes a standard 2" × 4⅛" lens, secured in the lens retaining frame by an improved spring. Connection between shield and the headgear provides better adjustment of lens angle with reference to the face. Featured are wide range of vision, ease with which the entire lens assembly can be pushed up out of the way when not needed, light weight and non-fogging characteristics.

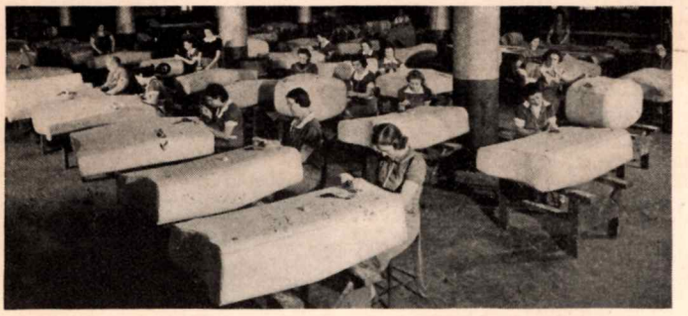
Planishing Hammer for Finishing Sheet Shapes

Model SFH 18-12 is the smallest of a series of pneumatic planishing hammers now being manufactured by Seiden Pneumatic Tool Co., Jackson, Mich.

Its main purpose is to hammer or iron out wrinkles formed in drop hammer stamped sheet structures, especially those having small radii whether they are made of aluminum, duralumin, stainless steel or other metals. By installing the proper shaped dies, the unit also can be used for light riveting, and can set rivets up to ¼" in dia.



Westinghouse's new variable voltage ac drive which permits a wide range of adjustable speeds in industrial applications



This scene in the factories of The B. F. Goodrich Co., Akron, shows employees working on fuel tanks for combat airplanes in which rubber linings and coverings make possible the rapid sealing of holes caused by machine gun fire

The hammer has a speed varying from 4000 to 8000 oscillations per min.; stroke can be adjusted from a feather touch to a blow heavy enough to shape and form 18 gauge steel.

The hammer bracket and the die support bracket can be raised or lowered to meet the requirements of the operator. Power and speed control valves are conveniently located directly over the cylinder, and foot control permits operator to start and stop hammer instantly.

Central Screw Fasteners Speed Assembly

A new line of fastening devices, called *Prestole*, and claiming speedier production and more rigid assemblies in their application, are announced by Central Screw Co., Chicago.

Formed by a special press operation, in cold-rolled steel, they embody a resilient conically formed and scientifically slit-thread, which, it is claimed, not only "invites" the entrance of a screw of matching thread, but, in addition creates an assembly of such quality as to obviate the necessity of a lock washer. Made from spring-steel, a quick, push-on type of fastener, known as the *Quickie*, is provided for one-time assembly. In the *Prestole*, one complete thread is provided, which is scientifically slit to create the effect of a fully tapped hole.

The Prestole method of fastening is offered in stampings of standard patterns, also special shapes to meet specific requirements.

Fluorescent Luminaires for High Level Lighting

A new fluorescent luminaire employing two of the recently announced 100-watt, 60", white, or daylight fluorescent lamps, and designed especially for general and supplementary high-level illumination in industrial or commercial areas was announced by the Westinghouse Electric & Manufacturing Co. This new 2-FPR-100 luminaire is ideal for supplying the high intensities needed in plants where production is being speeded, and it is available for operation on 110-125, 199-216, and 220-250 volts, 60-cycle ac.

Fixture consists of a hood, reflector, lamp holders, starting device, and ballast equipment. Access to line connections is easy as all auxiliary equipment is mounted and wired as part of the sheet steel hood assembly. Reflectors are 18 gauge porcelain enameled steel. Two types are available; the direct type which throws all light downward, and the diffuser type which allows a minimum of 2½% upward light to pass through apertures above each lamp to reduce brightness contrast between the lighted area and the ceiling. Both reflectors provide a 14 degree shielding angle below the horizontal, when viewed normal to the lamps.

Two-lamp ballast provides high power factor of over 90% minimizes stroboscopic effect and assures satisfactory lamp performance.

Units are arranged for rigid or flexible conduit, or chain suspension mounting. Levolier switches may be installed if desired. Standard units are shipped completely wired; and are finished with a smooth silver gray baked enamel.

Black & Decker Production Drill

A new ¼" standard ball bearing drill has been announced by Black & Decker.

A practical production drill with high power, compactness, and light weight, the unit is equipped with anti-friction bearings, splined gear mounting, locked inner and outer races on spindle bearing, and removable commutator end cover. With close offset and choice of end or side handle, this drill is particularly adapted to aircraft work, with a full range of spindle speeds to meet aircraft production requirements.

Black & Decker production drill

Its drilling capacity in steel is ¼"; ½" in hardwood. Standard speed is 2000 rpm, and is available, also, in speeds of 3500 and 5000 rpm.

Flexible Coupling for Fluctuating Torque Drives

Falk Corp., Milwaukee, has developed a new type of flexible coupling for connecting Diesel, oil, gasoline, or gas engines to any type of driven machinery. It is an excellent coupling for use with motor driven compressors, single cylinder pumps and other driven equipment of a similar fluctuating torque nature.

The Falk *Airflex* coupling is built to meet the need for a flexible coupling in which the degree of resiliency can be readily changed to suit the requirements of a particular application. It decreases peak torque values when either the prime mover or driven equipment has a high fluctuating torque characteristic. It consists of a special resilient rubber gland lined with a pre-moulded, pre-vulcanized cylindrical section treated to prevent air loss. This cylindrical lining is covered with multiple alternating layers of tough durable fabric and live rubber. The entire gland is permanently bonded to rugged steel inner and outer rims.

The gland is inflated to proper pressure through a specially designed standard thread Schrader valve which will take any hand pump fitting or air nozzle. A rubber covered metal cap prevents foreign material from entering the valve. The degree of elasticity in this coupling can be varied by changing the air pressure. This frequently eliminates the necessity for adjusting the setting of the connected units, or making changes in shaft diameters and lengths or in the flywheel, to alter the torsional characteristics of the drive system.

Improved Type of Drum-Dumping Stacker

Lewis-Shepard Sales Corp., Watertown, Mass., announced its recent development for smoothly and efficiently handling the dumping of drums, barrels and many other liquid or dry material containers.

This newly improved drum-dumping stacker, in addition to having the structural design of standard Master Stackers, permits control of the dumping operation by the operator from the floor. This eliminates standing on boxes, improvised platforms, *etc.*

A self-locking worm makes it possible to hold the drum instantly for as long as desired at any position. Control from the floor also permits the operator to reverse the tilt of the drum or barrel to slow down or stop the flow of material from the container.

Versatility of this stacker plus its ruggedness and efficiency of operation make it a valuable piece of equipment at this time.

Lewis-Shepard design and manufacture different types of special purpose stackers for dumping, storing, piling, the retention of materials at bench or work level, handling of materials on pallets. These are in addition to its standard lines of Master stackers, single stroke lift trucks, Master jacklifts, hydraulic footlift and handlift trucks, Floormaster factory trucks, and Weldmaster skid platforms.

12-oz. Plastic Injection Molding Press

Hydraulic Press Manufacturing Co., Mount Gilead, Ohio, has designed a 12-oz. single nozzle plastic injection molding press which was primarily designed to take care of the demand for injection molding of large plastic parts where multiple injection molding is not required. It will take over the work of the large die casting machines, permitting their production to go direct to the defense needs of America. H-P-M builds three smaller capacity injection presses of 2, 4 and 9-oz. injection capacity per cycle. These smaller presses are of single nozzle design, similar to the 12-oz. size except smaller in size. H-P-M also builds larger injection presses of 18 and 36-oz. with multiple injection units which are especially adaptable for large area work.

Fundamentally, the 12-oz. machine incorporates into its design the straightline hydraulic clamp which is important for the successful molding of large parts. The "live" hydraulic force that "backs up" the clamp assembly, after mold is closed, gives positive sealing of mold halves. Also this straightline hydraulic clamp automatically adjusts for molds of any thickness thereby keeping die set-up time to a minimum.

Speed of the injection plunger must be rapid to inject large quantities of material per cycle. This is especially true with the 12-oz. machine.

The 12-oz. injection presses are equipped with standard H-P-M *Hydro-Power* radial piston type pressure generators.

a QUIZ for AIRPLANE Buyers

What 2-place, side-by-side airplane has spin preventing wing slots?
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What airplane has an electric starter just like your automobile?
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What 2-place airplane carries all fuel where it is safest . . . in wing tanks?
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Through and through, the REARWIN SKYRANGER is the quality airplane in the 2-place field . . . packed full of value and hours of genuine pleasure. For an honest to goodness, 2S cross-country airplane at a price you can afford to pay, buy the REARWIN SKYRANGER.

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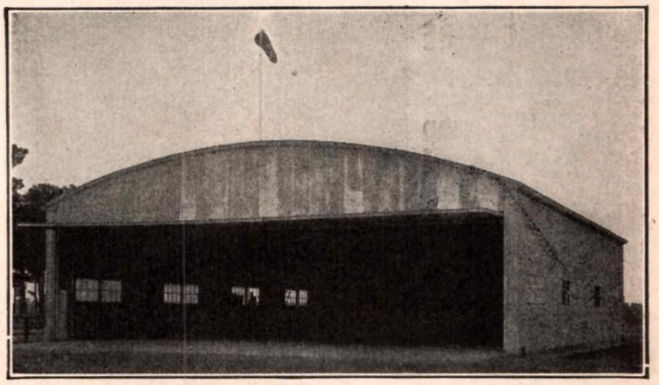

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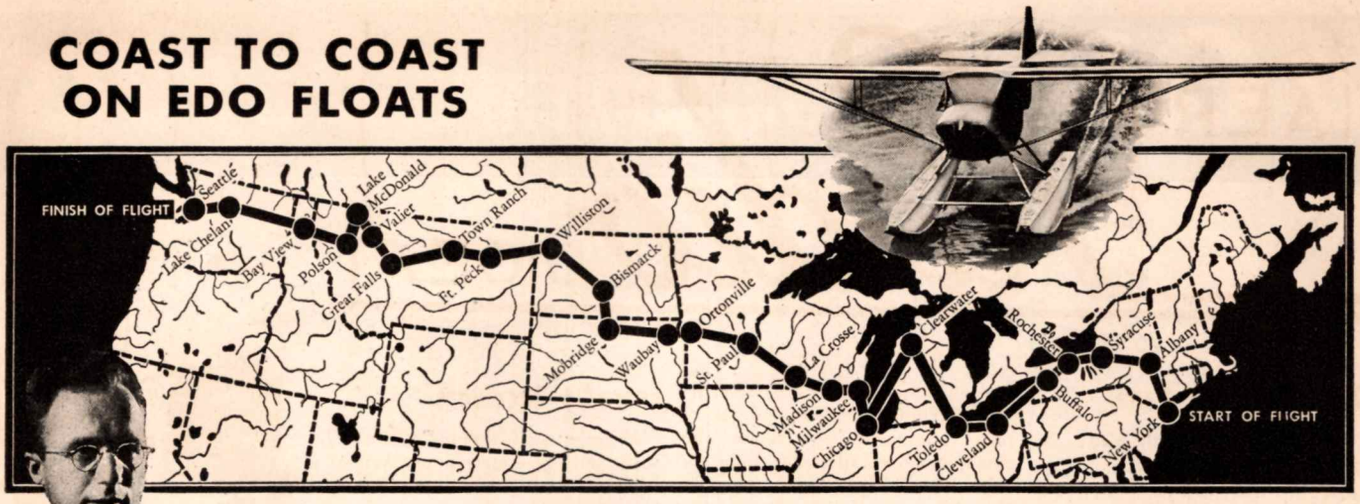

Wolfgang Langewiesche

CAN a light seaplane be flown readily across the United States? Would such a trip be pleasurable and relaxing, with water landings available at frequent, convenient intervals along the entire route?

Wolfgang Langewiesche, author and sportsman pilot, sought and found the answers to these questions. With only 5 hours of seaplane experience, he flew his 65-h.p. Lycoming-powered Taylorcraft fitted with Edo floats, from Manhattan's Wall Street seaplane base to Lake Union in Seattle.

Throughout his route, *shown above*, Mr. Langewiesche found an abundance of water areas suitable for landings and take-offs. To quote from his description of the flight—"lakes and rivers seemed to arrange themselves in a chain of emergency havens that was better than the best equipped civil airway . . . you can stop flying almost any moment you choose . . . I arrived at Seattle convinced that the seaplane is one answer to most of private flying's problems of safety, practical utility and fun."

With the crowded conditions and mounting restrictions encountered at so many airports today, a growing number of private flyers are becoming interested in the many unique advantages offered by water flying which has now been given so much impetus by the extensive system of seaplane bases constructed under the C.A.B. We will be happy to send a detailed description of Mr. Langewiesche's trip and up-to-the-minute facts about seaplane ownership and operation.

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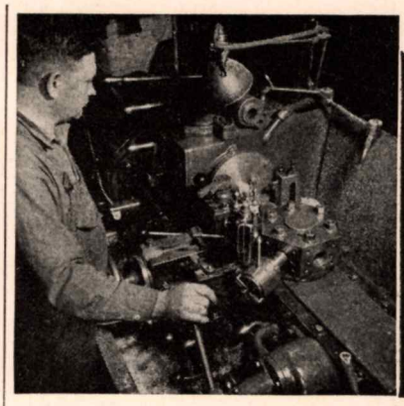

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AERO Radio DIGEST

Dispatch Check Panel

A new radio system, developed by TWA's radio engineers, provides an electrically-operated instrument that permits flight dispatchers to have a visual and automatic record of transport planes operating in any given area under their control. Under the present system, dispatchers depend upon radio advices from pilots to record the positions of planes aloft.

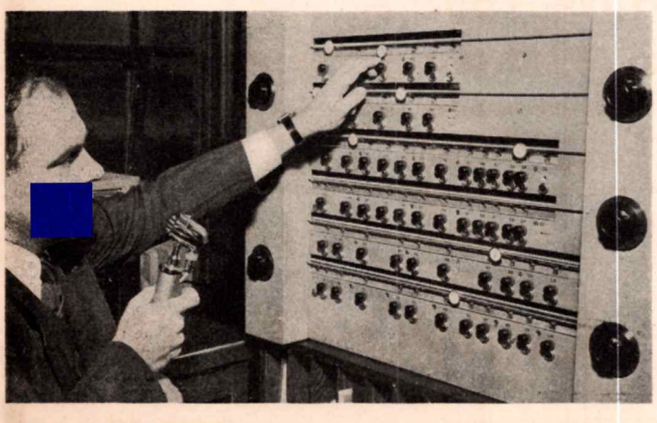
The device consists of a panel fitted with a series of tracks, each representing a directional airway. Each track works on a long, electrically-driven worm, which turns at 2 rpm, but the exact speed is regulated by a timer set to conform to the ground speed of the plane. A small brass block, representing the plane, operates along the track.

To operate the instrument, the miniature plane begins moving along the track at the moment the transport plane leaves a terminal. The speed of the worm is regulated according to the pilot's flight plan, which allows for weather conditions, cargo and gasoline load in pre-determining his true speed.

Check points on the airway are represented on the dispatch board by slots set at frequent intervals corresponding in scale to the airway. Each slot, or warning block, is set slightly beyond the plane's check point to allow the pilot a few seconds tolerance to make his radio report. As the miniature plane approaches this block, the dispatch office radioman, upon receipt of a check point message from the pilot, closes the block, allowing the "plane" to pass on to the next check point on the dispatch board.

If the miniature plane reaches the block before the pilot has reported, it drops into the slot and rings an alarm. This notifies the flight superintendent of the pilot's delay and an inquiry immediately is dispatched to the plane. As soon as the pilot reports reaching his check point, the miniature plane is placed on the track again and starts moving toward the next block. As soon as it passes a block, it automatically sets the block against any plane that may be following.

The development is expected to enable the flight superintendent to keep a positive, double-check on the plane's position—a check from the dispatch board and a corroborative advice from the pilot. It is planned to install the devices in TWA operations offices in New York, Chicago, Los Angeles and San Francisco and to set up a master board in the airline's headquarters office in Kansas City. When completed, the master board will coordinate the recordings of the other boards so that the KC Operations staff will have an automatic record of the positions of TWA planes in flight.



Howard K. Morgan, superintendent of communications for TWA, is shown demonstrating the "automatic block signal" system. Miniature planes move along a track at the same relative speed as the plane in flight

Learadio Receivers

Four aircraft radio receivers with built-in interphone systems were announced last month by Lear Avia, Inc., Dayton.

The new sets are improved versions of the dry-cell powered models AMR-1 and AMRL-1 and the 12-volt battery powered models AMR-12 and AMRL-12; the "L" models are arranged for operation from both the conventional antenna and from the improved model AMRL direction finding loop.

The new receivers are identical in frequency coverage, and differ only in their tube complements and power requirements, dimensions and weights. They are direct controlled and can be mounted on the airplane's instrument board.

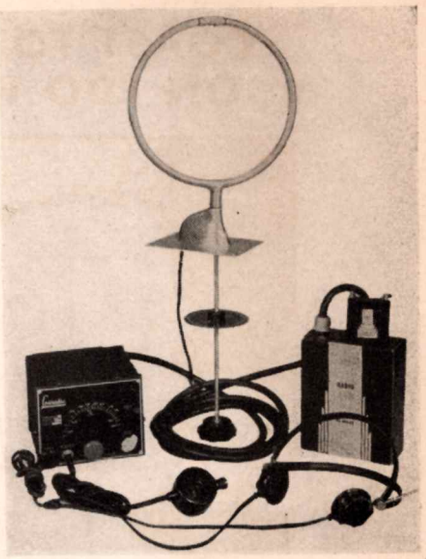
Covering the frequency range from 200 to 400 kcs, employing five tubes in a superheterodyne circuit, the receivers have a sensitivity of 3 microvolts for 50 milliwatt output on antenna, 50 microvolts per meter for same output on loop; both at 4:1 signal-to-noise ratio. Selectivity is 2 kcs. for 3 db, 12 kcs. for 60 db attenuation.

The receiver panel mounts vernier tuning control and dial, master on-off and volume switch, headset and interphone microphone jacks, and antenna trimmer. The "L" models are also equipped with an additional trimmer for the loop, and the loop antenna selector switch.

The interphone feature permits electrical intercommunication between persons using the receiver, and is a part of the receiver circuit.

The dry-cell powered models measure 4⅞″ high, 6⅛″ wide, 7⅜″ deep, and weigh 5 lbs. The 12-volt battery operated models measure 5 1/16″ high, 6¼″ wide, 7½″ deep, and weigh 8 lbs. These weights include cables but not the interphone microphone and the headset.

The dry-cell pack provides power for both the receiver and its companion transmitter, AMT-1. It measures 2⅝″ high, 5½″ wide, 7″ deep, and weighs 5 lbs. The normal life of the dry-cell pack is 150 hrs., slightly less when used for both the transmitter and the receiver.



Learadio receivers and loop

The 12-volt battery models are powered with a special dynamotor power unit, providing power for both the receiver and its companion transmitter, AMT-12. The power unit measures 4¼″ high, 5⅝″ wide, 9½″ deep and weighs 7 lbs. 11 ozs.

The direction finding loop operates on the aural null principle and is available for operation in conjunction with the AMRL-1 and the AMRL-12 receivers. Measuring 10″ dia., 13¼″ high, and weighing 28 ozs., complete, the loop is mounted on a streamlined pedestal and is direct controlled, with a direct-reading 360° azimuth indicator.

Synthetic Rubber Electrical Conduit

A new electric conduit called *Amerflex* has been placed on the market by Searle Aero Industries, Inc., Hawthorne, Calif.

Produced by American Aircraft Radio, division of the Searle concern, *Amerflex* is a flexible aluminum tubing encased in a lightweight synthetic rubber.

It is claimed that the tubing can be cut, stretched, or flexed and will return to its original shape. Tests show it has high resistance to tear and abrasion and withstands high temperatures as well as most coal tar solvents, denatured alcohol and gasoline, and acids and alkalies in concentrations.

It is recommended for use behind the instrument panel, in the engine nacelle, and inside the airplane where tubing is exposed to grease, oil, or dust.

Remote-Control Radio

American Aircraft Radio, division of Searle Aero Industries, Inc., Hawthorne, Calif., has developed a complete line of remote controlled aircraft receivers and transmitters.

This equipment is light in weight, and possesses high sensitivity and power. It is designed for installation without reconstruction of the custom instrument panels.

A small panel, containing control knobs and dial, is installed on the plane's instrument panel, the sets being placed where convenient, or most desired, and controlled through tachshaft and electric cable.

United UHF Equipment

United Air Lines last month ordered 100 new UHF radio receivers for immediate installation on its fleet of Mainliners, according to J. R. Cunningham, Director of Communications. The cost will approximate $100,000.

First use of the receivers will be made with the UHF range stations now being established by the CAA between New York and Chicago.

This type radio range is said to be superior to the low frequency type now in use because of its fidelity of transmission and freedom from static. Frequencies to be used on the New York-Chicago airway range from 119,000-126,000 kc as contrasted with the present 200-400 kc band.

The new stations will be located at North Beach, N. Y., Easton, Sunbury and Moshannon, Penn., Milbrook, Cleveland and Toledo, Ohio, Goshen, Indiana, and Chicago. These stations are expected to be in operation by July 1, by which time installation of the new receivers would be completed on United's *Mainliner* fleet.

New Radio CAATC's

Thirteen aircraft radio type certificates were issued by the CAA during January bringing the total to 382.

Lear Avia, Inc.

3274-A right angle drive
1747-A right angle drive
4846-A loop motor housing unit
RCBB receiver tuning unit

Bendix Aviation, Ltd.

3725 sensitivity control

Bendix Radio Corp.

MP-31B power unit
TA-2K transmitter
MN-28Q remote control unit
MS-6E radio control panel
MR-27C loop relay unit
MR-43A tuning control

Wilcox Electric Co.

S-101 beacon receiver
ATR-IS apparatus mount

FM for Finch

Announcement was made last month that Finch Telecommunications, Inc., Passaic, N. J., has been licensed by Maj. Edwin H. Armstrong, inventor of Frequency Modulation, to manufacture FM mobile communication and miscellaneous apparatus.

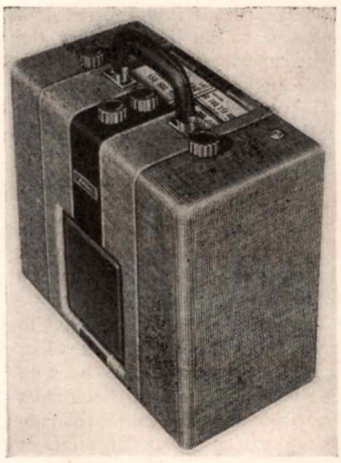
During the month, the FCC granted a license to Finch, to operate a facsimile experimental station at its laboratory at Bendix Airport. The station W2XAH is authorized to use frequencies between 30 and 40 megacycles, which are adjacent to FM channels with a power of 1 kw.

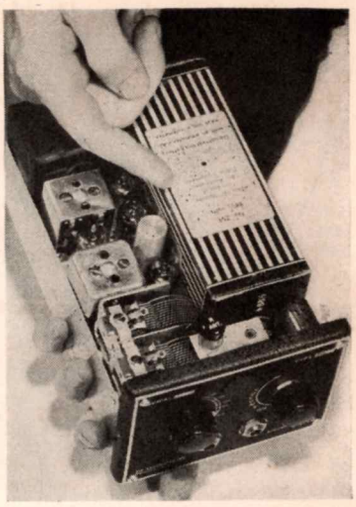
Portable Receiver

Sentinel Radio Corp., Evanston, Ill., announced last month their new Model 228-P portable radio receiver which is designed for reception of aviation 140-410 kc and entertainment 530-1520 kc frequency bands. A novel feature is the inclusion of a simultaneous radio range filter which can be switched into play as desired to reduce the percentage of radio range signal being received from a simultaneous radio range station whenever it is desired to obtain maximum available voice signal.

A jack is provided for use of headphones. This portable, which includes a complement of dry batteries providing approximately 200 hrs. of service, also includes provision for operation from 110 volts ac-dc.

A superheterodyne circuit including a stage of RF amplification is employed. A loop antenna is built in and connections are provided for external antenna and ground. The "slide-rule" tuning dial provides maximum legibility.





Air Associates BR-3T

Air Associates, Inc., announced last month the Model BR-3T transmitter-receiver for light aircraft weighing 10½ lbs. with dry batteries, headphones, microphone, cables, and shock mountings. This equipment is easy to operate since the pilot has only two receiver controls—the tuning knob and volume control, and one transmitter control—a microphone pushbutton.

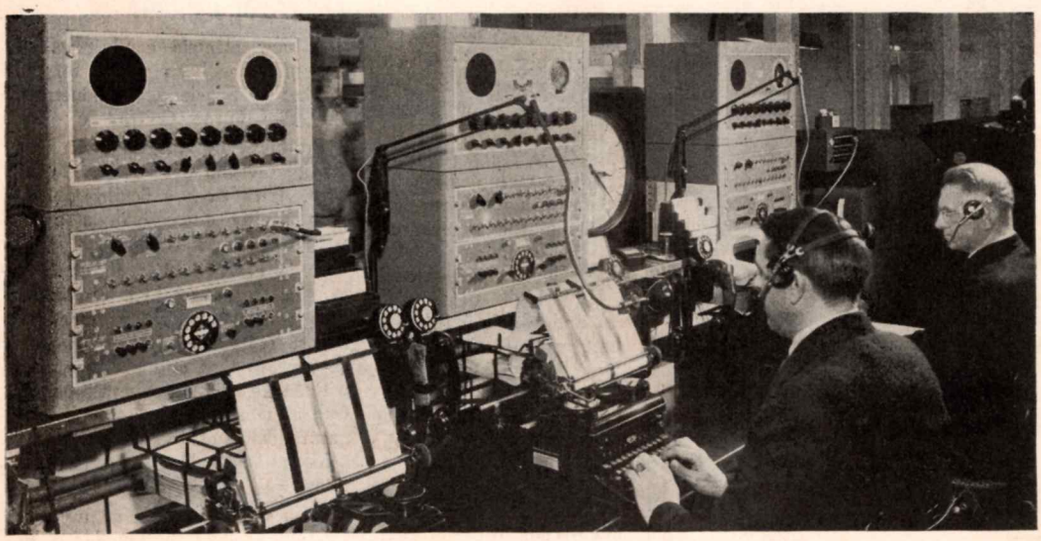
The receiver, tunable over the range of 200-400 kcs., provides reception of radiorange and weather and airport control tower transmission. The transmitter is crystal controlled on 3105 kcs. and has a power output of approximately 2½ watts. A whip antenna is recommended for the receiver. A specially designed combination insulator and end loading antenna unit provides for transmitting performance from a fixed antenna comparable to that normally obtained from larger trailing antenna.

The transmitter and receiver are housed in the same case, 4½" wide, 3¾" high and 7¾" deep. "B" power for the receiver and transmitter is supplied by two 90-volt dry batteries contained in another case of identical dimensions. "A" batteries, located in the same case with the chassis units, give sufficient power for approximately 100 hours of receiver operation and 7 to 8 hours of transmission.

Radio Control

Radio Control Headquarters, Grandby, Conn., last month released *The Radio Control Instruction Manual*, a booklet compiled by Clinton B. DeSoto and covering all phases of radio control of model aircraft.

This manual includes circuit diagrams as well as a listing of available components. In view of the rapid growth of radio control of model aircraft, it is believed this manual will find much demand. It is priced at $.10 a copy.



Typical of new radio control rooms being established by United Air Lines at major points along its routes is this station in the company's communications center at Chicago. The photo shows three of United's newly-designed control units for use in connection with remote transmitters and receivers, as well as special typewriters and forms used in keeping logs of voice communications between the radio operators and planes in flight

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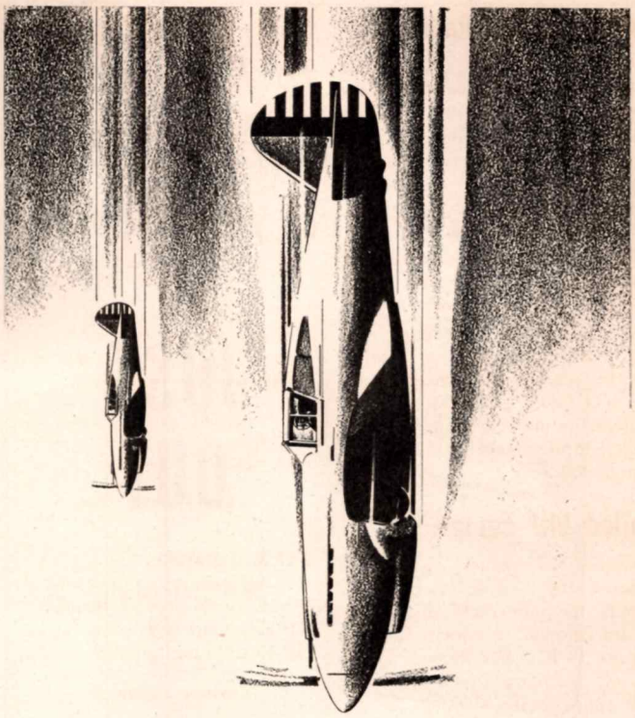

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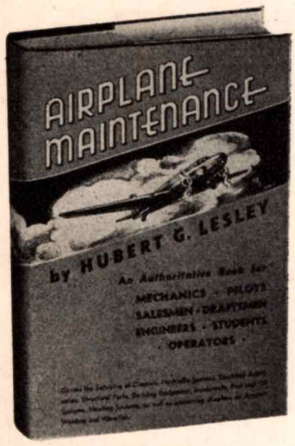

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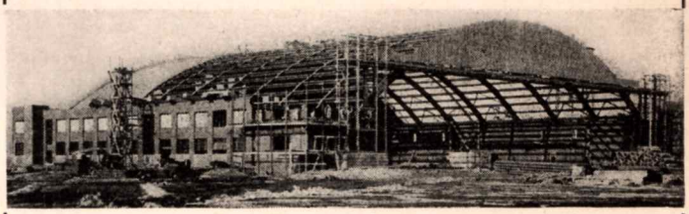

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Division of Bendix Aviation Corporation

TRADE LITERATURE

Instrument School

Chicago School of Aircraft Instruments, a division of Snyder Aircraft Corp., located at Chicago Municipal Airport, has issued a new bulletin which incorporates its curriculum.

Indicating the importance of instruments in the modern airplane, the booklet describes the courses offered at the school, and answers the questions a prospective student would want to know before he embarks on a career as instrument specialist. Ample illustrations provide a good idea of the school's facilities and capacities.

Metal

Catalog 40 has been published by Chase Brass & Copper Co., Inc., New York, N. Y., to meet customers' demands for a ready reference of what it has in stock, and what special brass, copper and bronze stock can be obtained.

There is a complete listing of brass, copper and bronze rolls, rod, bar, angles, wire, tubing, fittings and other Chase products. The book indicates gauges, sizes, and weights, and indicates the warehouses where the material is readily available.

Bolts, Nuts

Blue Book 41, published by Lamson & Sessions Co., Cleveland, contains a complete listing of the wide variety of products produced by the company. A useful guide in simplifying the purchase of these products, the book tabulates and prices many types of bolts, screws, lockwashers, nuts and other similar devices.

Supplies

Dycer Aviation Supplies, Los Angeles, has issued Catalog 9 which lists a part of the large stock it carries on hand to meet the needs of aircraft, engine and allied replacements. The catalog embraces AN and CAA-approved items; standard commercial aircraft supplies, and some items of obsolete equipment often required for replacement.

Bearings

Latest catalog on aircraft bearings published by Fafnir Bearing Co., New Britain, Conn., is designed to furnish the latest aircraft bearing information. It is a "must" for the aircraft designers' store of literature.

Interesting is the page devoted to drawings of typical installations, and informative are the charts and schematic drawings of the wide range of bearings produced by Fafnir.

Information and data are supplied for the types illustrated, the accompanying tables giving dimensions and characteristics of vital importance in design.

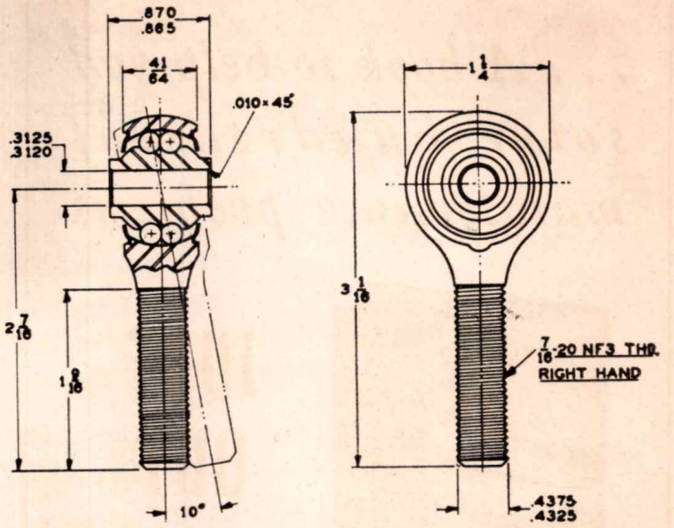
Gages

Quick-setting gages which provide a wide range of accurate measurements on close tolerances, have been produced by Standard Gage Co., Poughkeepsie, N. Y. These gages are described in a new catalog issued by the company, and the illustrations used show their application on aircraft engine parts.

The folder shows various types, including standard, pistol-grip and vertical, and shows their operation in actual use.

Variable Speed Control

With increased industrial production of all kinds the most important problem of the day, then should be interest in the booklet. "How to Speed Up Production with Variable Speed Control," published by Reeves Pulley Co., Inc., Columbus, Ind.

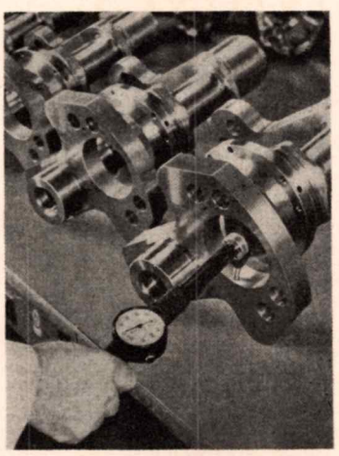


Fafnir rod end double row bearing type RE5M7

This 24-page booklet cites 36 specific examples in all types of industrial plants in which speed control made possible definite production increases and advantages.

With new machines so difficult to obtain, machines now in use can be made to do more work and better work by application of variable speed control.

In addition to production case histories, the book also includes illustration and description of the three Reeves speed control units, as well as the many different designs and controls available.



Checking i.d. of aircraft engine crankshaft, damper liner holes

Wrinkle Finish

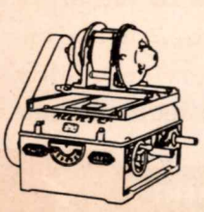
The Roxalin Flexible Lacquer Co., Elizabeth, N. J., has issued a 4-page bulletin on *Rincontrol*, their new wrinkle finish. This 8½" × 11" bulletin includes a sample finished panel and illustrates and describes eight exclusive Rincontrol features. Also shown are several outstanding products using this latest in textured enamel finishes.

Die-Casting Film

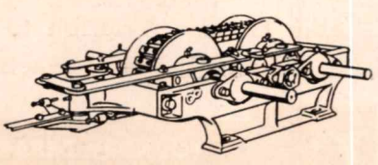
Tracing the ramifications of high pressure die casting of light weight alloys for the aircraft industry, Harvill Aircraft Die Casting Corp., Inglewood, Calif., has completed a 16 mm sound and color motion picture.

The story of the importance of die casting to industry in general, with particular reference to speeding up national defense work, is graphically portrayed in a manner understandable to the lay public while at the same time incorporating sufficient technical material to be highly informative to the engineering profession. Use of photomontages, aerial shots and animation adds interest to the film.

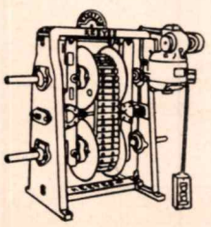
Production was handled by Pacific Industrial Films, with Hubbard Hunt acting as Associate Producer. Supervision of the picture was given by West & Asso-



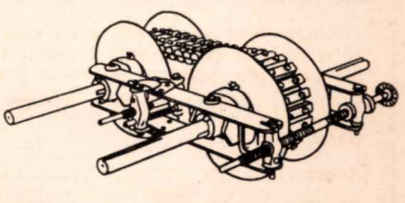
Horizontal enclosed design with individual motor drive



Unit equipped with mechanical automatic control

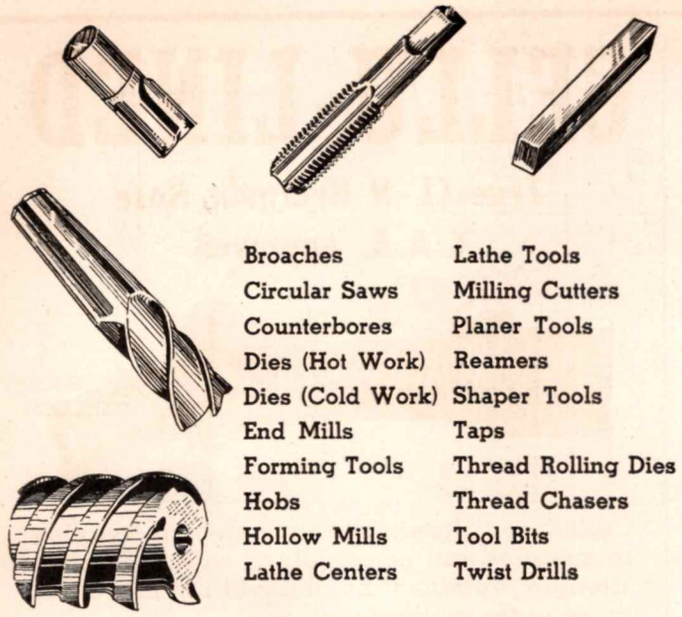


Vertical open unit with electric remote control



Internal operating parts only, without frame or enclosure

Various installations utilizing Reeves variable speed control units



Broaches	Lathe Tools
Circular Saws	Milling Cutters
Counterbores	Planer Tools
Dies (Hot Work)	Reamers
Dies (Cold Work)	Shaper Tools
End Mills	Taps
Forming Tools	Thread Rolling Dies
Hobs	Thread Chasers
Hollow Mills	Tool Bits
Lathe Centers	Twist Drills

Typical application of Jessop "Mogul" high-speed steel

ciates, Inc., Los Angeles agency for Harvill. The narration was done by Chet Huntley of KNX, who graphically outlines the steps involved. Filmed entirely on Kodachrome, the film is 1200 ft. in length with a showing time of approximately 45 mins.

The new film will be distributed, on an advanced scheduled billing, to aircraft engineering departments, Government and private aircraft schools and selected types of industrial audiences. Bookings are now being made through either West & Associates, or Harvill.

Portable Generating Plants

The Bardco line of generating plants has recently been broadened by the addition of seven air-cooled units, and ten water cooled totally enclosed models, that are designed to be easily portable and entirely self-contained. Outputs of the air-cooled units are 500, 1000, 1500 and 2000 watts at 6, 12, 32 or 110 volts dc or 110-220 volts ac. Features include light weight, automatic circuit breaker voltmeter on instrument panel, moisture proof generator windings, air intake cleaner, and integral fuel tank.

The water-cooled models represent the latest developments in streamline generating plants, and are standardly equipped with electric starter, built-in fuel tank, engine instrument panel complete with oil pressure, water temperature, and vaccum gauges, voltmeter and rheostat and battery ammeter. They are available in 3000 and 5000 watt sizes, ac or dc. The Master generators used on both the air-cooled and water-cooled plants are of the inherent voltage regulation type.

Form B-530 provides descriptive literature on these new units which are available from the Bardco Manufacturing & Sales Co., Dayton, or Los Angeles.

Industrial Thermometers

In January, 1938, the Instrument Division of Manning, Maxwell & Moore, Inc., Bridgeport, issued the finest and most complete 72-page Thermometer Catalog covering American industrial thermometers. They now announce that the 1941 edition of this catalog and text on industrial thermometers has been revised and brought up to date by including recent additions to the American thermometer line.

At the same time, they have streamlined the catalog with the new plastic binding, and other features which modernize this interesting catalog.

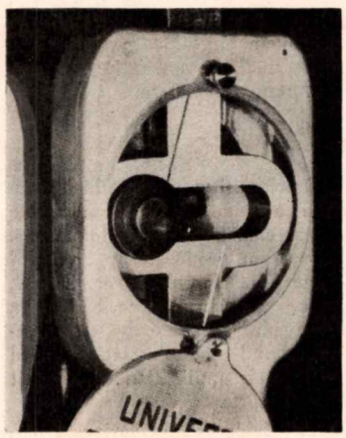
High Speed Steel

A new 12-page booklet on Mogul molybdenum tungsten high speed steel has just been published by the Jessop Steel Co., Washington, Pa.

There is a description of the advantages of Mogul over 18-4-1 high speed steels, including lower initial cost of steel, lower heat treating costs, and longer tool life on many jobs. A description of the physical properties of Mogul, approximate analysis, hardness values at varying drawing temperatures, and complete heat treating procedure are enumerated.

Precision Files

A particularly informative catalog on American Swiss Files has been published by the American Swiss File & Tool Co., Elizabeth, N. J., who have specialized in the manufacture of this type of file for more than 40 years.



Slotting head on Slotmaster

Introductory pages describe the origin of American-made Swiss Pattern Files, explain how these files are manufactured, illustrate different cuts, as well as comparative cuts, of Swiss Pattern and American or commercial pattern files, and include suggestions for the selection, use and care of files, to obtain best results.

More than 3000 different shapes, cuts and sizes of files are listed in the catalog, together with description and illustration of each shape and explanations of their use. Tool, die and pattern makers, jewellers, watchmakers, and others engaged on precision work are invited to write for the catalog.

Slotmaster

A 4-page catalog just released by Experimental Tool & Die Co., Detroit, features the universal *Slotmaster*, which can be adapted to all milling machines, providing double duty facilities at minimum cost. It requires but little time to change over from one head to the other and back again—making every milling machine potentially double duty equipment.

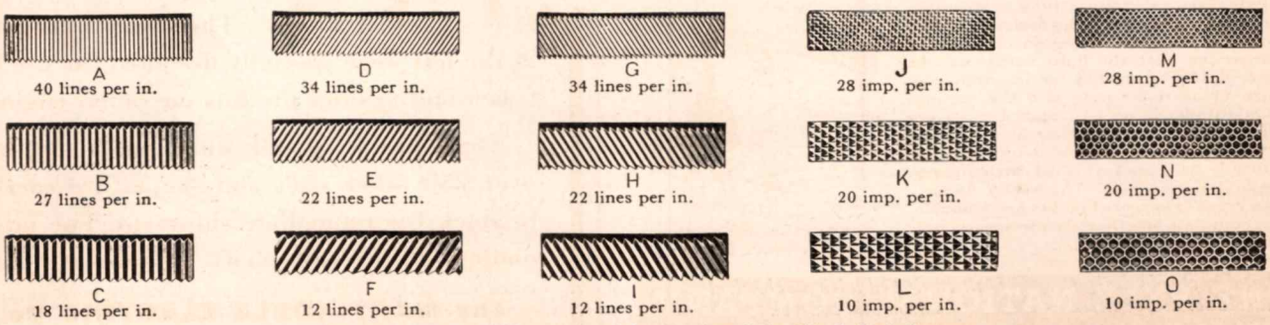
1941 Standards

The American Standards Association last month announced publication of a new List of American Standards for 1941. In view of the importance of standards and specifications not only for every-day work but to speed up production to meet defense requirements, this particular list of standards will be of unusual interest to industry.

More than 400 American Standards are listed, covering definitions, technical terms, specifications for metals and other materials, methods of test for the finished product, dimensions, safety provisions for use of machinery, and methods of work. They reach into every important engineering field and serve as a basis for many municipal, state, and federal regulations. Six hundred manufacturing, government and user groups have shared in the development of these standards.

These American Standards, developed as they are by the industrial groups themselves working through the American Standards Association, represent the best in current practice. Provisions are made for their frequent review in order to keep them in line with

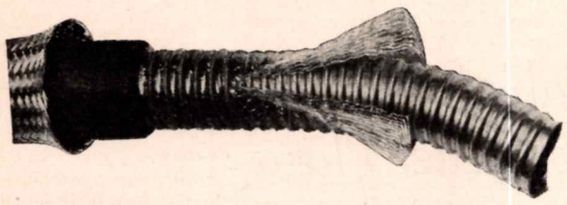
(Continued on following page)



Patterns and designs of files produced by American Swiss File & Tool Company

AVIOFLEX

Type AVIO-D Fuel and Oil Line Hose
C.A.A. Approved

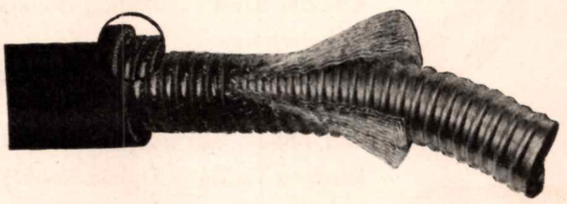


Avioflex Hose is oil-proofed with cellulose—a material completely resistant to action of hot oils and high test gasolines.

Sizes (I.D.) 3/16" to 1½". Pressures to 2600 p.s.i.

CELLU-LINED

Type CL-N Hydraulic Hose
C.A.A. Approved



Cellu-lined Hose is the equivalent of Avioflex in qualities and construction, with additional strength obtained by imbedding the metal braid in the synthetic casing.

Sizes (I.D.) 3/16" to 1". Burst pressure to 23,000 p.s.i.

COUPLINGS for Avioflex are readily attachable in your own plant, or, like Cellu-seal couplings, are factory assembled.

CHICAGO METAL HOSE CORPORATION

MAYWOOD, ILLINOIS

Write for Data and Engineering Recommendations on Specific Problems Involving Flexible Connections

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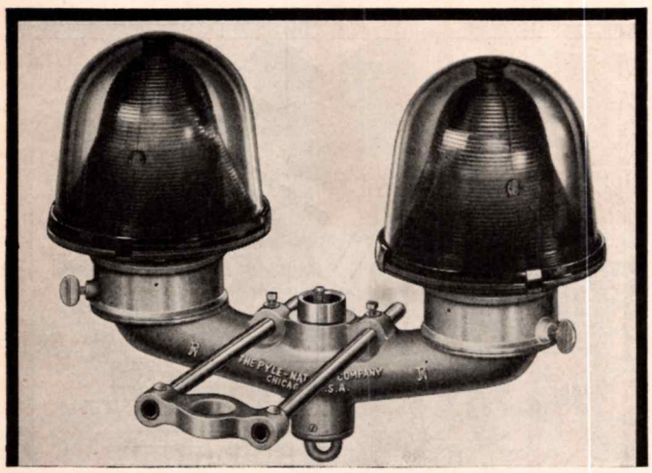
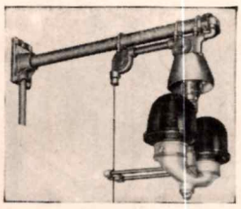


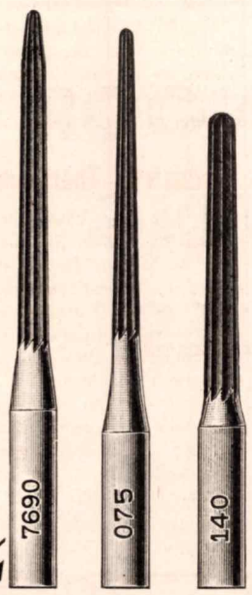
NEW OBSTRUCTION LIGHTS easily maintained on stacks, towers, and other tall structures

● Pyle-National hanger type obstruction light fixtures are especially designed for use with the Thompson Disconnecting Lamp Hanger, so that the light fixture can be lowered to the ground for maintenance. Hazards of re-lamping and the expense of maintenance on tall obstructions are avoided, and reliable service assured. This fixture is available in double unit type for multiple service, furnished with fittings for installation with Thompson hanger. Two types of approved globes are available. Get complete specifications in special bulletin, copies on request.



Fixture in latched position on Thompson hanger

THE PYLE-NATIONAL COMPANY
1334-58 North Kostner Avenue • Chicago, Illinois



MARTINDALE FILES and BURS

Rotary tools made from *Super High-Speed* steel.

The Burs illustrated at the left were specially designed for use between and around the fins on radial engines.

14 of these special Burs are made, and over 250 other sizes and shapes are carried in stock for immediate shipment. For information on Flexible-shaft equipment write:

The MARTINDALE ELECTRIC Co.
1406 Hird Ave. Cleveland, Ohio

The
INTERCONTINENT CORPORATION

Announces removal of its main offices from 30 Rockefeller Plaza, New York, to its own building at N. W. 36th St. & Lejeune Road,

MIAMI, FLORIDA

Effective May 1st, 1941

☆ **A Branch Office *will be maintained at 30 Rockefeller Plaza, New York***

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DRAWING
PENCILS

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each

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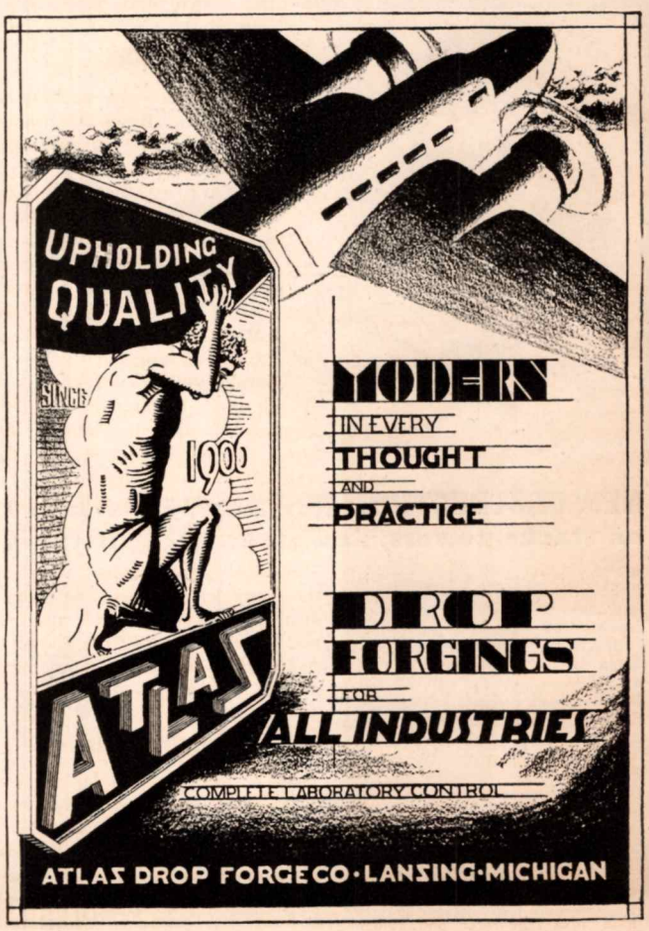
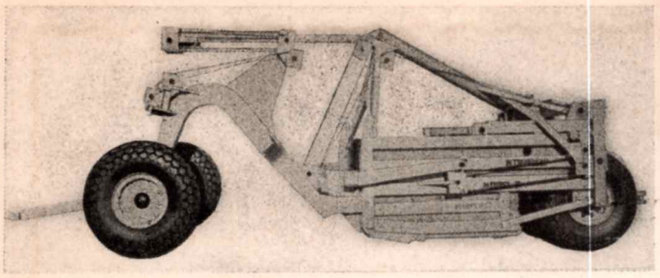
Manufactured in U. S. A.

KOH-I-NOOR PENCIL COMPANY, Inc.
373 Fourth Ave., New York, N. Y.





One of the allied units fitted to Caterpillar tractors

(Continued from preceding page)

a changing industrial set-up. Many of the standards listed here were brought up to date within the last year.

The list will be sent free of charge to anyone interested in the work. Requests should be addressed to the American Standards Association, 29 West 39th St., New York, N. Y.

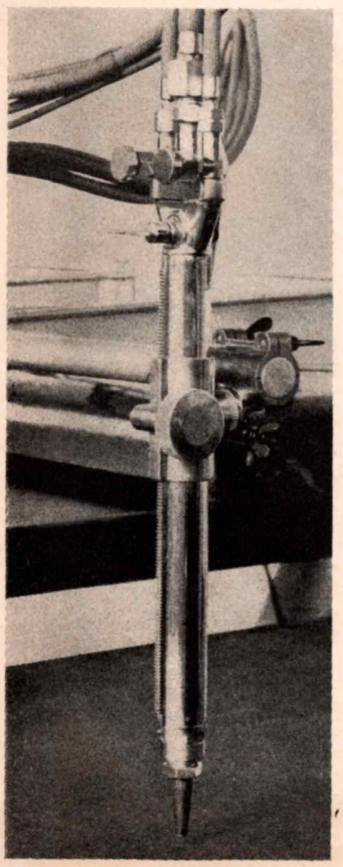
Welding

A comprehensive course of exercises covering the oxyacetylene welding process for the aviation industry has just been published by Air Reduction, New York. The purpose of this course is to provide a well planned series of exercises (67) to illustrate the varied conditions existing in the art of aircraft welding. It can be utilized also to train operators who have had previous experience in other lines of oxyacetylene welding.

This book sells for 50c per copy and may be obtained from Air Reduction Sales Co., 60 East 42 Street, New York.

Air Reduction also has published *Airco No. 10 Planograph*, a new 8-page bulletin which describes this gas-operated cutting machine designed for cutting straight lines, rectangles, circles and irregular shapes from ferrous metal of any thickness within the present practical limits of the cutting torch.

There is a complete pictorial representation of the Planograph, as well as operating details and specifications. Features of the device are listed, such as its wide cutting range, single or two-torch operation, centralized location of electrical controls, interchangeable devices for manual tracing or magnetic and templet tracing, and central gas control unit.



3-hose, rack-type torch and holder

Tractors

A catalog, devoted entirely to the new 80 hp Diesel D7 tractor, has just been issued by Caterpillar Tractor Co., Peoria.

Printed in three colors, the booklet points out the tractor's features by the use of numerous illustrations. Cutaway pictures show cross sections of the engine and the tractor chassis, while the accompanying text gives a complete description of all working parts.

Separate sections of the book are devoted to the fuel system, general engine construction features, the lubricating system, the transmission and final drive, the tracks and the track roller assemblies, operator comfort, and available allied equipment.

Smaller photographs, taken in the company's factory, show some of the precision methods used in the manufacturing of the machine. A complete tabulation of specifications is also included.

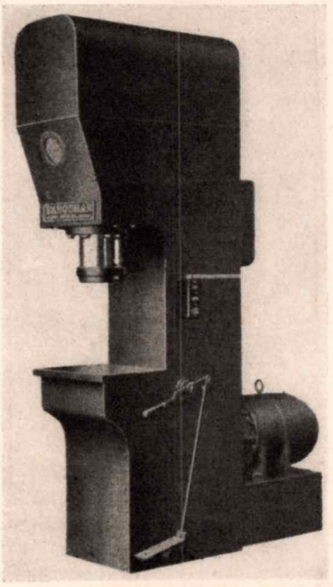
Subdrainage

At a time when extensive airport improvement and expansion is under way, the publication of any information which can be used as a guide or aid in any phase of the program, is welcome. Such a book is Toncan's (Cleveland) new book titled *Subdrainage with Toncan Drainage Products.*

Although only a small part of the booklet is devoted to airport work, nevertheless, there is enough material and data which is applicable at airports, that the book is valuable. It covers methods of constructing subdrains, types and requirements.

Presses

A 4-page bulletin, No. 41-H-01, recently issued by A. B. Farquhar Co., Ltd., of York, Pa., describes a line of hydraulic straightening and general purpose presses which should be of interest to aircraft purchasing agents.



Farquhar 15-ton open gap press

Interesting illustrations are coupled with complete specifications covering presses ranging from 3 to 300 tons capacity, and a 500-ton capacity shaft straightening press.

Rubber

A three page mimeographed reprint of the article *Semi-Conducting Rubber and Synthetic Rubber Compounds* by A. E. Juve of its mechanical division technical staff has just been released by The B. F. Goodrich Co., Akron. The article was published in a recent issue of *India Rubber World* and discusses some of the most interesting developments in rubber technology in recent years.

Dirt Hazards

A new 4-page illustrated folder titled *Dirt Is a Critical Hazard* and describing the application, operation, and dirt removing qualities of the Precipitron electrostatic air cleaner has been published by Westinghouse.

This attractive and informative folder tells briefly the complete story of the Precipitron and how it removes harmful dirt from the air. Successive paragraphs tell what the electrostatic cleaner is, how it operates, and why its efficiency is higher than other air cleaners. Sketches and other illustrations aid the reader throughout the explanations.

Places and industries where air cleaning can save money or valuable merchandise are listed. Installation and cleaning capacities are briefly covered, with a cutaway picture of a typical Precipitron installation included.

Last page of the folder contains a list of successful Precipitron installations in various industrial business and commercial locations. Capacities of these installations are listed to give those interested a general idea of the extent of air cleaning necessary.

Transmissions

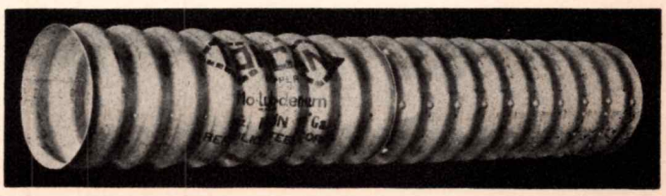
Let in the Light with Western Transmissions is the subject of a 4-page catalog just released by Western Manufacturing Co., Detroit.

For motorizing various Cone driven machine tools, two models of transmissions are featured—a *Master* (1-5 hp) and a *Major* (5-10 hp), together with Multi Motor Mount, which accommodates all *Nema* frames No. 204 to No. 326 (1-15 hp at 1800 rpm), including practically all Canadian, British, South American and overseas motors, together with older and special motors up to 10 hp used in the United States.

Planers

Catalog No. 152 depicts and describes in detail the latest design of planers produced by The Liberty Planer & Manufacturing Co., Hamilton, Ohio.

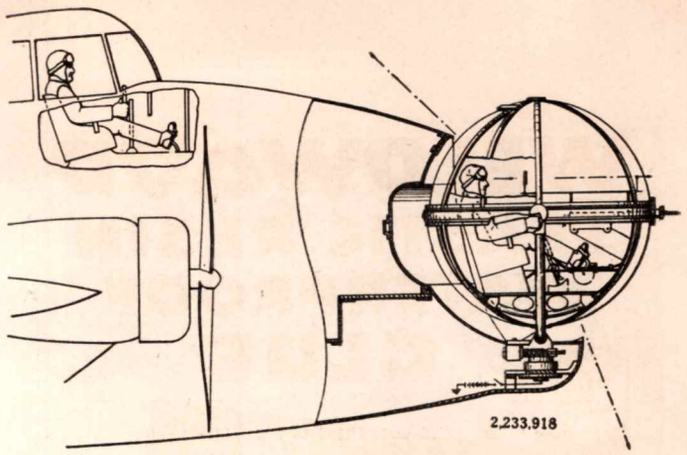
Latest engineering developments have been incorporated in the design of every type planer and with their many outstanding features, this catalog should interest purchasers and users of machine tools.



Toncan perforated corrugated pipe to allow infiltration of ground water

TREND OF INVENTION

These patents, of interest to the aeronautical industry, were compiled from recent issues of the *Official Gazette* of the U. S. Patent Office. Copies of the individual patents, in pamphlet form, may be obtained from the Commissioner of Patents, Washington, D. C., at a cost of ten cents each.



Vent plug for aircraft batteries. Almond H. Snyder, Lancaster, N. Y., assignor to National Battery Co. (2,232,279)

Aircraft having a sustaining rotor. Ralph H. Upson, Ann Arbor, Mich., assignor to Autogiro Company of America. (2,232,289)

Fuel control means. Stanley M. Udale, Detroit, Mich., assignor, by mesne assignments, to Chandler-Evans Corp. (2,232,351)

Airplane carburetor. Milton J. Kittler, Detroit, Mich., assignor, by mesne assignments, to Chandler-Evans Corp. (2,232,392)

Remote controlled indicator with stabilized head, pitch, and bank indicating unit. Paul Kollsman, Stamford, Conn. (2,232,537)

Acceleration indicator. Jacob L. Shroyer, Oak Park, Ill. (2,232,567)

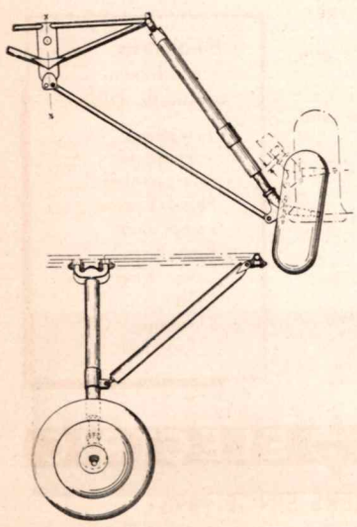
Telemetric device. Ralph R. Chappell, Richmond, Va., and Rutger B. Colt and Robert J. Streb, Baltimore, Md., assignors to Bendix Aviation Corp. (2,232,589)

Magneto. Walter J. Spengler, Sidney, N. Y., assignor to Bendix Aviation Corp. (2,232,645)

Production of high quality benzine and diesel motor fuels. Theodor Wilhelm Pfirrmann, Ludwigshafen-on-the-Rhine, Germany. (2,232,673)

Design for an airplane. Richard M. Fruits, Oxford, Kans. (123,595)

Aircraft landing gear. Alex Francis Arcier, Dayton, and Max P. Baker, Tippecanoe City, Ohio, assignors to Waco Aircraft Co. (2,233,191)

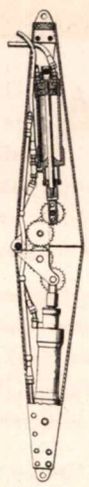


Pitch changing mechanism for oppositely rotating propellers for aircraft. Charles W. Lloyd, Greensboro, N. C. (2,232,683)

Method of making plywood. James V. Nevin, Aberdeen, Wash. (2,232,718)

Control apparatus (for establishing and maintaining a predetermined interrelation in the speeds of operation of at least two engines each of which drives a propeller). Rosser L. Wilson, Mahwah, N. J., assignor to The American Brake Shoe and Foundry Co. (2,232,753)

Aircraft undercarriage. George Herbert Dowty, Cheltenham, England. (Reissue 21,724)


Re. 21,724

Tachometer. Paul Kollsman, Stamford, Conn., assignor, by mesne assignments to Square D Co. (2,232,789)

Frequency meter (for indicating altitude of an aircraft above terrain). Richard F. Lane, South Orange, N. J., assignor to Bell Telephone Laboratories, Inc. (2,232,858)

Automatic servo rudder trimming device. Kurt Tank, Bremen, Germany, assignor to Focke-Wulf Flugzeugbau G.m.b.H. (2,232,982)

Aircraft power plant supercharger. Nathan C. Price, Seattle, Wash, assignor to Sirius Corp. (2,233,031)

Means for coupling together pipes, tubular bodies, and the like. Boyd Neil Robert Lamont, Wimbledon, London, England, assignor to Tube Patents Ltd. (2,233,214)

Fastening device. George A. Tinnerman, Rocky River, Ohio, assignor, by mesne assignments, to Tinnerman Products, Inc. (2,233,230)

Means for controlling aircraft engines. Edward Dodson, London, England. (2,233,307)

Variable pitch propeller. Blaine B. Gemeny, Western Springs, Ill. (2,233,364)

Design for a compass. Walter E. Hull, Warren, Ohio. (125,445)

Method for indicating the wear on bearings and other surfaces. Hobart C. Dickinson, Washington, D. C., and Samuel A. McKee, Bethesda, Md., assignors to the Government of the United States, as represented by the Secretary of Commerce. (2,233,403)

Variable pitch propeller. Oliver E. Barthel and Norman E. Marker, Detroit, Mich. (2,233,468)

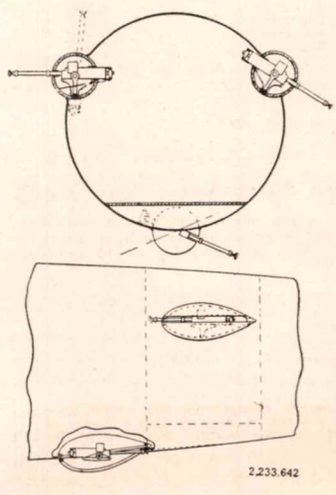
Resilient torque meter (in a power plant crankshaft-propeller system, a reduction gear between the shaft and propeller). Edward S. Taylor, Cambridge, Mass., assignor to Wright Aeronautical Corp. (2,233,498)

Apparatus for double spot or seam welding. Gerhard Hagedorn, Berlin-Halensee, and Walter Hass, Klein-Machnow, near Berlin, Germany, assignors to Bernhard Berghaus. (2,233,526)

Spark plug. Gilbert C. Barnes, Manchester, Conn., assignor to United Aircraft Corp. (2,233,660)

Lateral aircraft gun mount. John C. Sanders, Seattle, Wash., assignor, by mesne assignments, to Boeing Aircraft Co. (2,233,642)

Airplane machine gun mount.



Howard M. Fey, Portland, Ore. (2,233,918)

Geared connecting rod means for engines. Charles Lanier Lawrance, New York, N. Y., assignor to Lawrance Engineering and Research Corp. (2,233,669)

Helicopter. Alois Riedl, Dresden, Germany, assignor to the firm Henschel Flugzeug-Werke Aktiengesellschaft. (2,233,747)

Method of riveting. Vladimir H. Pavlecka, Santa Monica, Calif., assignor to Douglas Aircraft Co., Inc. (2,233,820)

Liquid control valve. Gustave J. Koehler, Dayton, Ohio. (2,233,840)

Magnesium base alloy. John C. McDonald, Midland, Mich., assignor to The Dow Chemical Co. (2,233,953 & 2,233,954)

Engine starter control. Albert H. Winkler and Emil O. Wirth, South Bend, Ind., assignors to Bendix Aviation Corp. (2,234,015)

Visual indicator for radio course. Christopher Sydney Cockerell, Danbury, England, assignor to Radio Corp. of America. (2,234,023)

Propeller. Walter E. Burnham, Detroit, Mich., assignor to Freedman-Burnham Engineering Corp. (2,234,073)

Welding control system. Gerhard Hagedorn, Berlin-Lichterfelde, Erwin Luxer, Berlin-Sudende, and Ernst-Günther Wahl, Berlin-Steglitz, Germany, assignors to Vertriebsgesellschaft des Leipziger Leightmetallwerk m.b.H. (2,234,117)

Propeller. Elbert Hawkins, Joliet, Ill. (2,234,120)

Propeller or rotor construction. Richard H. Prewitt, Lansdowne, Pa. (2,234,196)

Coated aluminum. John S. Thompson, Detroit, Mich., assignor to Metal Finishing Research Corp. (2,234,206)

Radio communication system. Erich Gossel, Berlin, Germany, assignor to C. Lorenz Aktiengesellschaft. (2,234,244)

Adjustable reclining chair. Hans Luckhardt, Berlin-Dahlem, and Anton Lorenz, Berlin-Schoneberg, Germany. (2,234,266)

Distance determining device. Irving Wolff, Merchantville, N. J., assignor to Radio Corp. of America. (2,234,329)

(Continued on page 185)

WELDWOOD PLASTIC RESIN WATERPROOF GLUE

*Approved for AIRCRAFT by U. S. NAVY and C. A. A. when properly applied **

WELDWOOD WATERPROOF GLUE is the first and only TIME-TESTED one-part cold setting PLASTIC GLUE. Standard Shear Tests both Dry and Wet developed 100% wood failure in every test specimen.

***SAMPLE OF WELDWOOD GLUE, test reports and process specifications are available on requests made on firm letterheads.**

The USP Research Laboratory is at customers' disposal in reference to special glueing problems.

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THE CYCLOPAEDIA OF CURRENT AIRCRAFT PRACTICE

OF, by, and for the *Technicians of the industry, Aircraft 1941 is the Bible of Aeronautics. It is clear, concise, and comprehensive on all aspects of civil and military aircraft production. It has been designed, and is tooled, to tell you what you want to know—about today's problems and procedure in the design and development of aircraft and their components—when you want to know it. You cannot afford to be without Aircraft 1941. Be sure of getting your copy by ordering it now.

SPECIFICATIONS

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Height	1.50	Illustrations	64.1
Weight (in pounds)		**Production Cost (in $)**	
Gross	3.79	Editorial	2,000
Volume (in pages)		Art Work	1,200
Books:		Engravings	1,600
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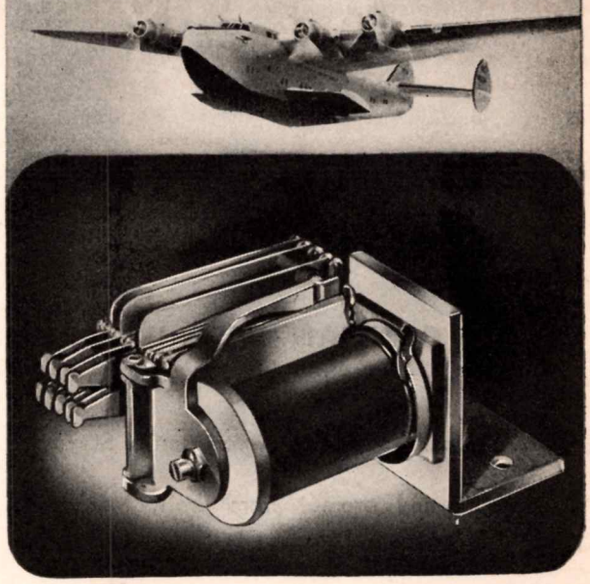

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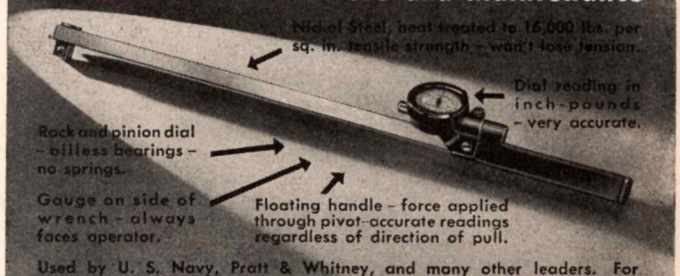
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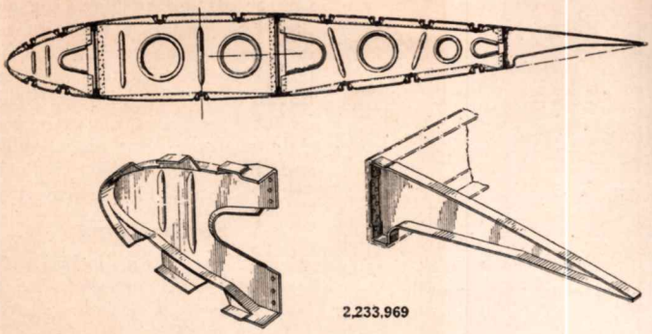


2,233,969

(Continued from page 182)

Pressed wing rib. Robert J. Woods, Grand Island, N. Y., assignor to Bell Aircraft Corp. (2,233,969)

Supporting carriage (a vehicle adapted to run on rails for moving aircraft on the ground) and *launching airplanes from water.* Reuben H. Fleet, William B. Wheatley, and Isaac M. Laddon, San Diego, Calif. (2,234,522 & 2,234,750)

Hardened nonferrous alloy. Reginald S. Dean, Washington, D. C., and Clarence T. Anderson, Pittsburgh, Pa., assignors to Chicago Development Co. (2,234,552)

Anchor nut. Daniel C. Hungerford, Madison, N. J., assignor to Elastic Stop Nut Corp. (2,234,557)

Shielded ignition manifold system. Edwin A. Robertson, Sandusky, Ohio, assignor, by mesne assignments, to Bendix Aviation Corp. (2,234,579)

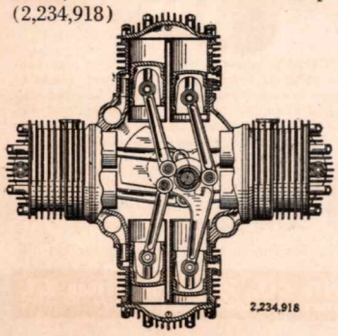
Radio direction finding system. Horace T. Budenbom, Short Hills, N. J., assignor to Bell Telephone Laboratories, Inc. (2,234,587)

Direction finder. Wilhelm Runge, Berlin, Germany, assignor to Telefunken Gesellschaft für Drahtlose Telegraphie m.b.H. (2,234,654)

Take-off control and method (a hold-down mechanism for holding an airplane to a launching vehicle) and *holding device for an airplane.* Reuben H. Fleet, William B. Wheatley, and Isaac M. Laddon, San Diego, Calif. (2,234,751 & 2,234,752)

Cooling arrangement for gas turbines. Albert E. Gibson, Lynn, Mass., assignor to General Electric Co. (2,234,757)

Internal combustion engine. Owen C. Linthwaite, South Bend, Ind., assignor, by mesne assignments, to Bendix Aviation Corp. (2,234,918)

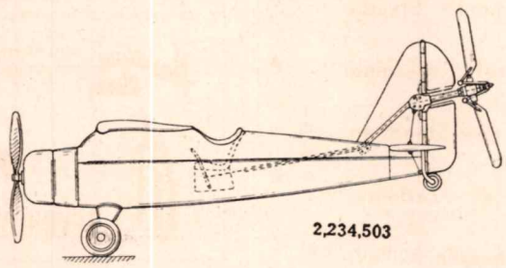


2,234,918

Impulse method of direction finding. Kurt Dziewior, Berlin, Germany, assignor to Telefunken Gesellschaft für Drahtlose Telegraphie m.b.H. (2,234,334)

Device for the filling of tanks (in an airplane wing) and *Aerial navigation machine.* Félix Amiot, Neuilly-sur-Seine, France. (2,234,393 & 2,234,394)

Aerodynamic retarder. James G. Ray, Hatboro, Pa. (2,234,503)



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Cooling arrangement for gas turbines. Anthony J. Larrecq, Beach Bluff, Mass., assignor to General Electric Co. (2,234,767)

Lubricating system. Samuel R. Puffer, Saugus, Mass., assignor to General Electric Co. (2,234,777)

Cooling arrangement for gas turbines (for aircraft) and *Gas turbine.* Wayne H. Allen, Lynn, Mass., assignor to General Electric Co. (2,234,792 & 2,234,793)

Radio beacon. David G. C. Luck, Haddon Heights, N. J., assignor to Radio Corp. of America. (2,234,828)

Electric welding method (method of butt welding two tubular pieces of work). Frank H. Rehse, Dayton, Ohio, assignor of one-fifth to Max Isaacson. (2,234,855)

Process and apparatus for expanding tubes. Heinrich Heetkamp, Buderich, Bezirk Dusseldorf, Germany. (2,234,863)

Airplane. Kurt Tank, Bremen, Germany, assignor to Focke-Wulf Flugzeugbau G.m.b.H. (2,234,883)

Method of determining the form and controlling the production of geodesics. Barnes Neville Wallis, Weybridge, England, assignor, by mesne assignments, to Vickers-Armstrong Ltd. (2,234,906)

Clamp for perforated sheet material. Edward K. Degener, Los Angeles, Calif. (2,234,938)

Radio location finder. Carl J. Rasmussen, Washington, D. C. (2,234,980)

Antenna system (wireless signaling equipment for use on board aircraft). Hans Eggers, Berlin, Germany, assignor to C. Lorenz Aktiengesellschaft. (2,235,015)

Method of making aircraft propeller blades. James H. McKee, Pittsburgh, Pa., assignor, by mesne assignments, to Curtiss-Wright Corp. (2,235,032)

Beaching gear. Eddie Molloy, Ypsilanti, Mich., and William C. Keller, North Tonawanda, N. Y., assignors to Curtiss-Wright Corp. (2,235,034)

Starter gearing. William L. McGrath, Elmira, N. Y., assignor, by mesne assignments, to Bendix Aviation Corp. (2,235,076)

Temperature compensated pressure responsive indicating instrument. Frederick J. Ottley, Bloomfield, N. J., assignor to Bendix Aviation Corp. (2,235,110)

Engine starter drive. Youston Sekella, Elmira, N. Y., assignor, by mesne assignments, to Bendix Aviation Corp. (2,235,121)

Radio antenna system (for aircraft). Malcolm Bruce, Plymouth, Mass. (2,235,139)

Airplane (aircraft wing including a normal cambered airfoil having a recess in the rear lower part thereof). Harlan D. Fowler, Baltimore, Md. (2,235,146)

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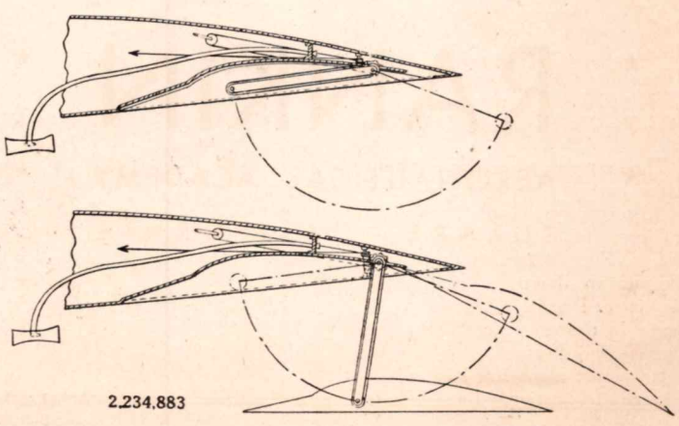

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Electric gun. Arthur A. Cole, Newark, N. J. (2,235,201)

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Means for machining curved surfaces (for reproducing and finishing compound curved surfaces of airplane propeller blades). William H. Ford, Williamsville, N. Y. (2,235,578)

Two stage compression arrangement for aircraft engines. Henry Charles Alexandre Potez, Meaulte, France. (2,235,588)

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Homing impulse direction finder. Theodor Sonnentag, Berlin. Germany, assignor to Telefunken Gesellschaft für Drahtlose Telegraphie m.b.H. (2,236,015)

Mechanical time fuse (in an explosive projectile). Youston Sekella, Elmira Heights, N. Y., assignor to Bendix Aviation Corp. (2,236,037)

ARTICLES IN FOREIGN TECHNICAL MAGAZINES

Vibrations

Calculation of the Flexual Vibration Frequencies of a Rotating Propeller Blade (Calcolo delle Frequenze di Vibrazione Flessionale di una Pala d'Elica in Rotazione. E. Lorenzelli. l'Aerotecnica, Vol. XX, No. 11; Nov. 1940)

The problem of the calculation of the flexual vibration frequencies of a rotating propeller has been treated by many investigators. At the outset the author reviews the results of previous work by Griffith, Southwell, Berry, Webb and Swain, Lürenbaum, Carter, Caldwell, Morris, and others. He points out that the theoretical calculations so far have not been in sufficiently good accord with experimental findings.

According to Lorenzelli, the discrepancy can be traced to excessive simplifications resorted to in the past. Accurate prediction of flexural vibration frequencies requires more rigorous determination of the propeller blade's elastic axis and accurate account of the mass distribution and geometry of the blade.

Taking into account by more exact formulas the elastic, form and mass properties of the blade, the author shows how theoretical calculations of frequencies can be brought into accord with the experimental results.

Human Flight

Referendum on Human Muscular Flight. Which Approach Will Lead to the Realization of Natural Human Flight? (Referendum sul Volo Umano Muscolare. Quale Strada Portera alla Realizzazione del Volo Umano Naturale? R. Chiappulini. l'Aerotecnica, Vol. XX, No. 12; Dicembre, 1940)

The first chapter of human flight dates back to the dim beginning of history as we know it through folklore, fables and ornamental design. Even Aztec stones hint of the human dream of conquering air space. Despite the modern advance in the science of flying the early desire of man to fly by muscular power alone has had only a meager realization. But despite small success the desire has not been abated and in several countries the work goes on. A National Committee for Natural Human Flight has been formed in Italy.

The present brief note summarizes some of the problems and possibilities of human muscular flight. The author points out that two promising approaches lie in the use of an ordinary sailplane equipped with pedal-operated propellers and an ornithopter. Both of these types, however, are difficult of practical realization and, according to the author, are limited in their use to exceptional athletes capable of delivering high power output above average ability.

Shimmy

Oscillation of Castoring Wheels. A Simple Investigation of the Damping Required to Overcome "Shimmy" in Tricycle Undercarriages. J. Lockwood Taylor, D.Sc. Aircraft Engineering, No. 143; Jan. 1941

This brief note presents a simplified analysis of the amount of damping necessary to prevent shimmy of a nose wheel. It neglects the inclination of the castoring axis, the damping of the tire, the flexibiltiy of the structure and the gyroscopic couples. Since the first two factors, although stated to be negligible, are considered by many to be important in their contribution to damping, the analysis presented by Dr. Taylor is a conservative one.

Design

Tricycle Undercarriage Development. A German Engineer's Review of the Evolution of this Component in the USA. W. Wernitz, Aircraft Engineering, No. 143; Jan. 1941

This article is a translation of the original which appeared in *Luftwissen* Vol. 7, No. 3, March 1940. With customary German thoroughness, the author has compiled practically all available material on the application of tricycle landing gear to various American airplanes. In addition to the descriptive material, certain technical facts are interjected.

Structures

Indications on the Reinforcing Effect of the Skin Covering in Wing Structures Having Ribs and Two Beams and Its Method of Calculation. (Indagine sull 'Effetto Irrigidente della Lamiera di Rivestimento nelle Strutture Alari a Due Longheroni con Centine e Metodo di Calcolo per Esse. G. Santangelo. l'Aerotecnica, Vol. XX, No. 12; Dicembre 1940)

The problem of torsional stiffness of cantilever wings has been treated in several recent Italian articles. The author of the present paper outlines the limitations of these various treatments and states the scope of the present investigation. It is assumed that the wing has a rectangular planform and is loaded simultaneously torsionally and flexurally. The beams and ribs are assumed to be of variable rigidity.

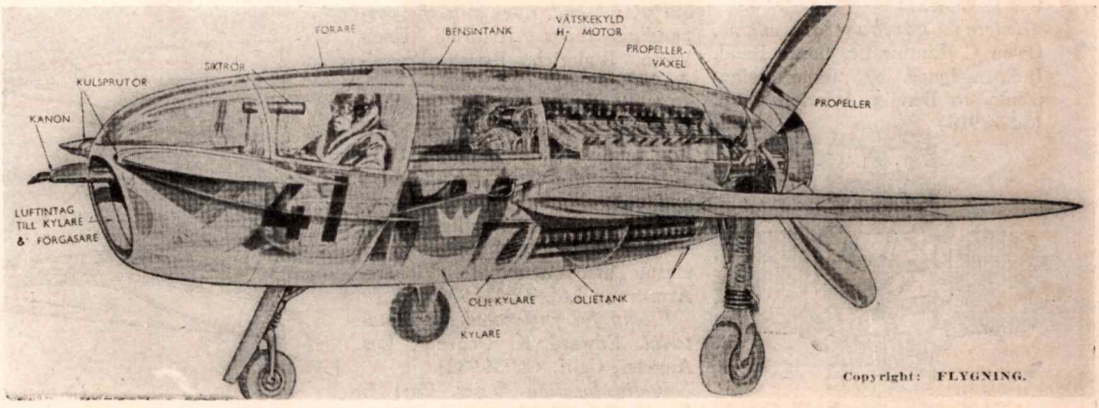
To simplify the problem, an assumption is made, however, that the wing may be subdivided into sections of uniform rigidity within the section itself. It is also assumed that ribs have an infinite flexural and shear rigidity while being incapable of resisting torsion. Making use of Minelli's method, the article analyzes the structure by first neglecting the effect of the covering and later showing its contribution to the rigidity of the assembly. The author concludes that the reinforcing effect of the covering can be taken care of by introducing fictitious flexural and torsional rigidity of the beams and torsional rigidity of the beam-rib assembly and solving the problem without further regard to the covering.

Spotwelding

The Spotwelding of Light Alloys. Gordon H. Field and H. Sutton. Aircraft Engineering; No. 143, Jan. 1941

This exhaustive paper constitutes the first Interim Report of the R52 Sub-Committee on the Spotwelding of Light Alloys of the Research Council of the Institute of Welding. The scope of the paper may be judged from the following summary of the items which were examined by the Committee: Duralumin and Aluminum Coated Duralumin Alloys. 1—Spotwelds on sheets of similar thickness; (a) X-ray examination, (b) micro-examination, (c) shear tests on single spot specimens as welded, (d) shear tests on single spot specimens after normal heat treatment, (e) shear tests on single spot specimens made with program control, (f) shear tests on single spot specimens after exposure to corrosive conditions, (g) fatigue tests on single spot specimens as welded, (h) fatigue tests on single spot specimens after normal heat treatment, (i) fatigue tests on single spot specimens made with program control.

2—Spotwelds on sheets of dissimilar thicknesses: (a) shear tests on single spot specimens as welded. 3—Spotwelds between sheets and extrusions: (a) shear tests on single spot specimens as welded. 4—Effect of spacing of welds on their shear strength. Aluminum-magnesium alloy MG 7. Spotwelds on sheets of similar thickness, (a) shear tests on single spot specimens as welded, (b) shear tests on single spot specimens after exposure to corrosive conditions, (c) fatigue tests on single spot specimens as welded.



Artist's sketch of proposed Swedish single-seater fighter

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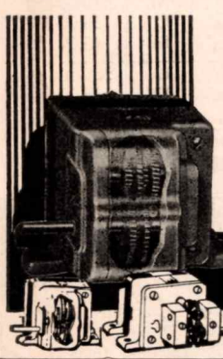

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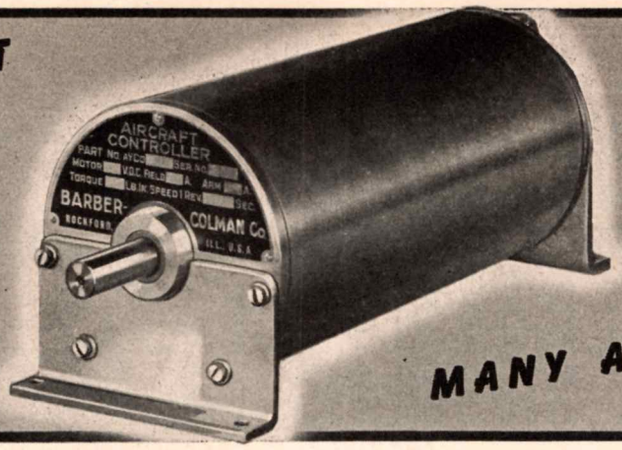

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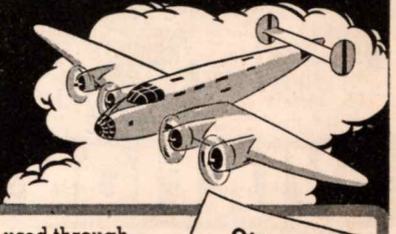

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HANDBOOK OF WELDED STEEL TUBING, Published by Formed Steel Tube Institute, 1621 Euclid Ave., Cleveland. 86 pp., loose-leaf; pocket size, $1.

Improvements and refinements in the processes employed for manufacturing welded carbon and alloy steel tubing during the past 10 years have resulted in the adoption of this material for structural uses in many large industries. There are inherent advantages in welded tubing due to the fact that it is formed from flat rolled strip and therefore has high physical properties and true concentricity of section. The Handbook has been published to furnish designing engineers with full information regarding standard sizes and properties of welded tubing.

The book is exclusively devoted to those grades of welded tubing which can be figured as having a solid wall structure with no discontinuity or variation in physical properties occurring in the area affected by the welding operation during manufacture. Standard sizes, together with commercial tolerances for roundness, wall thickness, straightness, *etc.*, are tabulated for various grades of welded tubes. Manufacturing and fabricating processes are illustrated, and dimensioned drawings show to what degree welded tubing can be cold worked in such operations as bending, beading, flanging, expanding, tapering, *etc.*

Special attention is given to recommendations for laying out fabricated parts and methods of checking. The reader is further provided with suggestions which will aid in developing designs for the most economical use of tubular sections. Numerous illustrations have been selected to show the wide variety of possibilities for using tubular members.

•

ANALYTICAL DESIGN OF HIGH SPEED INTERNAL COMBUSTION ENGINES. Fred M. Cousins. Published by Pitman Publishing Co., 2 W. 45 St., N. Y., N. Y. 233 pp., numerous diagrams. $3.50.

The need for a comprehensive and well-organized work on the dynamics of high speed engine design is met in this book.

It should be invaluable to designing engineers and advanced students since it is a concise and graphic study of particular use in the stages of design preceding actual layout of in-line, Vee-type, radial, and off-set cylinder engines. For practical purposes, analysis has been restricted to the Calculus and simple Harmonic Theory.

After outlining briefly the different thermodynamic cycles and giving a graphical method outline for constructing the indicator diagram, the author takes up balance of the various types of engines and provides examples. He gives a deflection method of crankshaft balance by which alone, in his experience, best running condition is obtained. Here are general methods of obtaining frequencies of torsional vibrations of crankshafts, including a highly useful graphical method; development of equations for lift, velocity and acceleration of commonly used cams; a time-saving method of harmonic analysis which can be applied to any form of valve lift curve; the general method of analysis for combined bending and torsion of crankshafts; firing orders of the more common types of engines. A bibliography also is provided.

•

THE SHIPS AND AIRCRAFT OF THE U. S. FLEET. James C. Fahey. Published by Ships & Aircraft, 1265 Broadway, New York, N. Y. 488 pps., numerous illustrations; soft covers. $.75.

This newest edition of a book which has appeared regularly for a number of years, contains considerable information concerning our fighting ships and the Navy's air arm.

It is right up to date, and is accurate, informative and detailed —where details are permissible.

The aircraft section is really an interesting piece of work. Not only are the various types of naval aircraft well illustrated, but the accompanying data is interesting, informative and accurate. There are tables showing the disposition of the various aircraft units on board ships and at land bases, short discussions describing the types of aircraft and their uses in naval aviation activities, and an explanation of naval designations and nomenclature.

•

ELEMENTARY AERODYNAMICS. D. C. M. Hume. Published by Pitman, 2 W. 45 St., New York, N. Y. 136 pp., numerous drawings. $1.50

This book is the product of lectures given by the author to students, and covers a working knowledge of aerodynamics prepared so that any reasonably educated person can understand it.

It is a well-written product which clarifies the elementary laws of the science of aviation. Questions and answers at the back of the book are most helpful, and the scope of the work is indicated by a chapter summary showing coverage of air, flow, forces, lift, trim, control, stability, maneuvers, propulsion and performance.

•

HANDBOOK OF INDUSTRIAL FABRICS (Third Ed.). George B. Haven. Published by Wellington Sears Co., 65 Worth St., New York, N. Y. 789 pps., including appendix; numerous illustrations, charts, tables. $2.

Revised and enlarged, this Handbook covers the entire field of fabrics. Although fabrics constitute only one factor in aircraft construction, their application is important in military aircraft and critical in light aircraft. Therefore, the purchaser in the aircraft factory should know something about the various forms in which they are available and of the various qualities.

This new edition has a number of additions and improvements. Particularly, there is a complete revision of Chapter 1, by Dr. Robert M. Macy, Wellington's economist, which covers the marketing of cotton in the U. S., together with significant statistics regarding acreage yield and production.

Chapter 8 has been revised to give effect to the new ASTM specifications of textiles as approved in 1940, and there is added a rather complete bibliography of selected government publications on textiles.

•

METEOROLOGY (2nd Edition). Donald S. Piston. Published by The Blakiston Co., 1012 Walnut St., Philadelphia. 233 pp., 13 maps, tables, problems. $3.

Thoroughly modernized, entirely rewritten, clearly and concisely presented, this textbook contains the material for a semester course in the science of the weather.

There is important new matter on air mass methods and the application of the air mass analysis to weather phenomena and the practical problems of forecasting. The chapter on clouds conforms to the International Classification, and new cloud pictures are included.

Some of the climatic charts have been replotted using two modifications of Cahill's Octahedral Projection. Useful tables, lists of collateral and reference reading, and well chosen problems are included in this new book.

DESIGNATIONS—NOMENCLATURE

Naval aircraft are divided into classes in accordance with the mission or missions they are designed to perform. The letter "V" signifies a heavier than-air craft as "Z" signifies a lighter-than-air craft. Airplanes are designated by a group of 1 ters and numbers, as: SB2U-2. The "SB" indicates an airplane of the Scout-Bomber class; the "2" between the letters that it is the second Scout-Bomber model produced by the manufacturer—identified by "U" as Vought-Sikorsky. The last number "2," following the dash, indicates the Series of the Model, in this case the second. The letter "V" is omitted from the designation of individual models but is employed relative to classes (as: 18 VSB's . . . eighteen Scout Bombers) and in abbreviating the names of Squadrons (as: VS-72 . . . Scouting Squadron 72). As naval airplanes are added to the Navy List each is assigned a Serial Number that serves to identify the individual planes of each model (as: SB2U-2 number 1366, above). Serial Numbers run from 0001 to 9999; each run is identified alphabetically. The "A" run, completed during 1935, included World War and earlier models . . . The first ten-thousand naval airplanes. Those now on order fill out the "B" run and we'll shortly enter "C."

AIRCRAFT (Heavier Than Air) TYPE SYMBOLS	MANUFACTURERS LETTERS	MANUFACTURERS (1)	LOCATION
VF.....Fighting	A—BREWSTER	Brewster Aeronautical Corp., Long Island City, N. Y.	
VB.....Bombing	A—Atlantic-Fokker (1930)		
VBF.....Bombing-Fighting (*)	B—BOEING	Boeing Aircraft Co.	Seattle, Wash.
VS.....Scouting	B—BEECHCRAFT	Beech Aircraft Co.	Wichita, Kan.
VSB.....Scout-Bombing	C—CURTISS	Curtiss-Wright Corp., St. Louis, Mo., and Buffalo, N. Y.	
VT.....Torpedo	D—DOUGLAS	Douglas Aircraft Co., Inc.	Santa Monica, Cal.
VTB.....Torpedo-Bombing	E—BELLANCA (1937)	Bellanca Aircraft Corp.	New Castle, Del.
VP.....Patrol	F—GRUMMAN	Grumman Aircraft Engineering Corp., Bethpage, L. I.	
VPB.....Patrol-Bombing	G—Great Lakes (1935)		
VPT.....Patrol-Torpedo (*)	H—HALL-ALUMINUM	Hall-Aluminum Aircraft Corp.	Bristol, Pa.
VO.....Observation	H—STEARMAN-HAMMOND (1937)	Stearman-Hammond Aircraft Corp., San Francisco, Cal.	
VOS.....Observation-Scout	J—NORTH AMERICAN	N. A. Aviation, General Motors Corp., Inglewood, Cal.	
VSO.....Scout-Observation	J—Berliner-Joyce (1934)		
VJ.....Utility	J—General (1932)		
VJR.....Utility-Transport	K—FAIRCHILD (1937)	Fairchild Aircraft Corp.	Hagerstown, Md.
VR.....Transport (Multi-Engined)	K—KINNER (1935)	Kinner Motors, Inc.	Glendale, Cal.
VG.....Transport (Single-Engined)	K—Krieder-Reisner (1934)		
VN.....Training	K—Keystone (1931)		
VSN.....Scout-Training	L—BELL	Bell Aircraft Corp.	Buffalo, N. Y.
VM.....Miscellaneous (Obsolete)	L—Loening (1932)		
X.....Experimental Prefix	M—MARTIN	Glenn L. Martin Co.	Baltimore, Md.
A.....Amphibian	N—NAVAL AIRCRAFT FACTORY	U. S. Navy Department...Navy Yard, Philadelphia, Pa.	
AIRSHIPS (Lighter Than Air) See Page 35	O—LOCKHEED	Lockheed Aircraft Corp.	Burbank, Cal.
	O—Viking (1936)		
	P—SPARTAN	Spartan Aircraft Co.	Tulsa, Okla.
RIGID AIRSHIPS	P—Pitcairn Autogiro (1931)		
ZRS.....Rigid Scouting (*)	Q—STINSON	Stinson Aircraft Corp.	Wayne, Mich.
ZRP.....Rigid Patrol (*)	R—MAXSON-BREWSTER	W. L. Maxson Corp.	New York City, N. Y.
ZRN.....Rigid Training (*)	R—RYAN	Ryan Aeronautical Corp.	San Diego, Cal.
NON-RIGID AIRSHIPS	R—Ford-Stout (1932)		
ZNO.....Non-Rigid Observation	S—VOUGHT-SIKORSKY (Formerly SIKORSKY)	Division, United Aircraft Corp.	Stafford, Conn.
ZNS.....Non-Rigid Scouting	S—STEARMAN	Division, Boeing Aircraft Co.	Wichita, Kan.
ZNP.....Non-Rigid Patrol	T—NORTHROP (Now DOUGLAS)	El Segundo Division, Douglas Co.	Inglewood, Cal.
ZNN.....Non-Rigid Training	U—VOUGHT-SIKORSKY (Formerly CHANCE-VOUGHT)	Division, United Aircraft Corp.	Stratford, Conn.
ZMC.....Experimental Metal-Clad	W—WACO (1936)	Waco Aircraft Co.	Troy, Ohio
KITE BALLOON AND BALLOON	Y—CONSOLIDATED	Consolidated Aircraft Corp.	San Diego, Cal.
ZKO.....Observation	Z—Pennsylvania Autogiro (1935)		
ZKN.....Training			

(*): None in Service 1940. (1): Year of last contract. Omission of address indicates builder inactive.

A chart, reprinted from Fahey's new edition of "The Ships and Aircraft of the U.S. Fleet," showing aircraft designations in the Navy

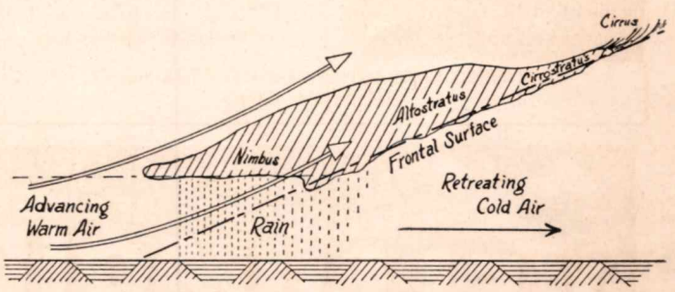


FIG. 89.—Vertical cross section of a warm front.

A typical illustration from Piston's "Meteorology"

FACTORY EXPANSIONS

(Continued from page 152)

tion engineers, completed parts will move onto the conveyor for assembly, and after passing 14 stations, the completed airplane will be wheeled off at the end of the line.

At first, four strips of movable floor will be installed along 400 of the 600 ft. of the building's center bay. Eventually, there will be six strips in all.

Costing more than $1,250,000, the new assembly plant is 600 by 400 ft. It is divided into three principal parts—the center bay along which the production lines will move mechanically to a hangar area measuring 200 by 200 ft.; the north bay where the wing department will be located, service and receiving rooms to which will come all the parts manufactured at Bell's Buffalo plant; and the south wing which will house the fuselage assembly.

The north bay will have 13-ft. head room and will measure 600 by 100 ft. A 50-ft. traveling crane will service the wing line. After completion of assembly, wings will be wheeled through a paint spray booth and then will be ready to be joined to the completed fuselages moving down the assembly line in the center bay.

The south bay will have 20-ft. head room. Here will be assembled and painted the aft fuselage section and other subassemblies of the *Airacobra*, using parts shipped from the Buffalo plant. Subassemblies from the south and north bays will move into the center bay, which measures 600 by 200 ft. and has 30 ft. of headroom. The sub-assemblies join the assembly line where necessary, an elaborate overhead traveling crane being used to facilitate their movement.

Of the 14 stations in the center bay, 10 will be on the endless belt conveyor. It is expected that each of the four assembly lines will turn out about one plane a day, and when the two additional lines are added, as is planned, the daily output of the Falls plant will be increased to six. At capacity production 3000 persons will be employed in the Niagara Falls assembly operations.

GOVERNMENT PLANTS

Announcement last month by the War Department of the award of contracts to The Austin Co., and the Manhattan Construction Co., sets in motion the construction of the largest air-conditioned windowless blackout aircraft plants ever constructed. Austin is charged with the design and construction of the Fort Worth plant and the Manhattan Construction Company will construct the Tulsa plant. Designs of the two plants will be as nearly identical as possible except where affected by local conditions, such as topography of the land, and preliminary investigations indicate that the differences will be minor. Because of this, Austin will furnish the engineering designs for both projects.

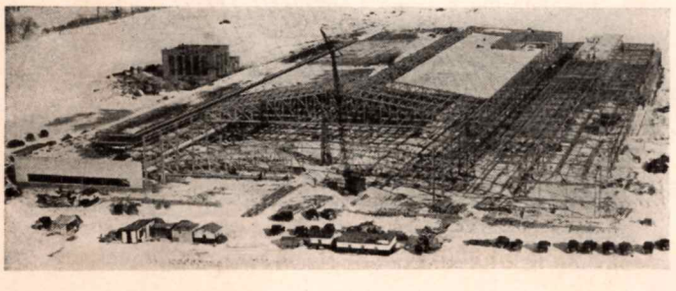
Consolidated Aircraft Corp. have been retained by the Corps of Engineers, U. S. Army, as consultants to lay out, to advise and direct the design of these plants which will initially produce, during the emergency, the Consolidated B-24 bomber. Consolidated will operate the Fort Worth plant, the Douglas Aircraft Co. the Tulsa plant. Both plants are to be supplied with component assemblies and parts from a Ford-operated plant to be erected at Ypsilanti, Mich.

Each plant consists of three main buildings. The largest of these is the main assembly plant, measuring 4000 ft. in length and 320 ft. in width, and containing a continuous assembly line. This line will be operated on the principle used for many years in the industry whereby the line has an intermittently timed movement, each airplane progressing from station to station at regular intervals until the completely assembled airplane is discharged at the end of the building. In this scheme of production the planes progress in the line from crew to crew. Each specialized crew will be continuously supplied with the necessary parts, materials and component assemblies at each station with the work timed so as to produce at the rate of fifty B-24 airplanes a month. The line will be moved by mechanical means, can be operated at longer timed intervals between movements when the plant first starts operating, and as the work speeds up it can be speeded up to meet the increased efficiency of the operations.

The assembly line will start with as many as three rows of airplanes in line finishing with a single line of airplanes having outer wings in place. The line will be operated on one side of the building in the main assembly bay which is 200 ft. wide and extends the entire length of the building. The feeder bay, alongside of the main assembly bay and 120 ft. wide, contains a double railroad siding with cross-over tracks permitting delivery of parts and component assemblies at the point in the line where they are to be used.

Alongside of the railroad siding in the 120 foot bay and next to the assembly line is a large working space where the parts and assemblies received from the Ford company will be unloaded and made up into complete pre-assemblies such as tail units, wing units with flaps and ailerons in place, *etc.* From their respective locations, they will be forwarded directly into the final assembly line. The clear height of 40 ft. inside the building, the wide assembly bay of 200 ft., and the various dimensions of the feeder bays will permit the construction not only of the four-engined B-24 but also larger types with as much as 195 ft. span, and weighing upwards to 200,000 lbs. each.

Fort Worth has several large lakes which can accommodate large flying boats, and for this reason Consolidated preferred the site since it is the largest company assigned to the production of U. S. Navy flying boats and if it later becomes necessary, could devote the plant to the manufacture of this type of aircraft. When the Fort Worth plant is completed and occupied by Consolidated and their program is completed at San Diego, Consolidated will have 5,600,000 sq. ft. of floor space—3,700,000 sq. ft. at San Diego and 1,900,000 sq. ft. at Fort Worth.



View of Bell Aircraft Corp. factory as it neared completion at Niagara Falls, N. Y.

A LETTER FROM ENGLAND

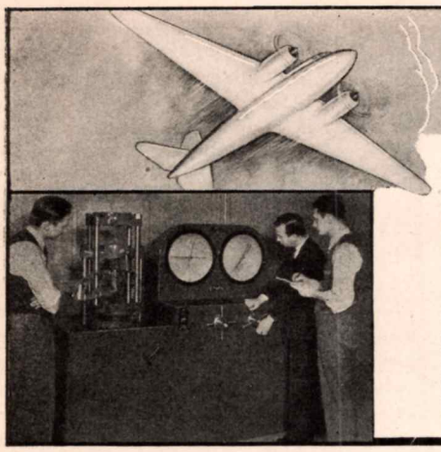
(Continued from page 62)

Communist. For one thing, I don't think the standard of happiness is as high in Russia as it is, say, in the U.S.A. or Australia. Put a man in a motor car and he gets a sensation of power; put him in a nice house and he gets a sense of possessiveness. That's not a good seed-bed in which to sow Communism. Why should everything belong to the State?

The Communist finds fertile ground in devastated areas. He scoots hither and thither telling people this is a Capitalists' War. He plays on unhappiness, disaster, want, hunger, for this gives him his fertile seed-bed and he works it for all he is worth. The *Daily Worker* wants us to make peace with Hitler, to sabotage production, to short-circuit the war effort. It was banned. When the police arrived, one of the printing press workers admitted that he was expecting them, and in typical proletariat language he said, "I don't agree with the policies of those bastards upstairs." He was referring to the editorial staff; the men on the presses even demanded the removal of certain scurrilous passages.

Of course, there is the privileged class,

(Continued on page 193)



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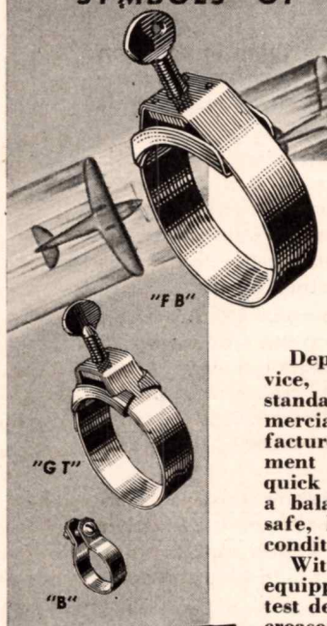

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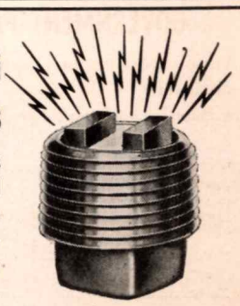

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The R.A.F. Benevolent Fund, Patron and former president, King George VI, founded in England following the World War, and functioning "for the relief of distress among all ranks of the Royal Air Force and their dependents," has done a fine job of rehabilitation, education and medical care. Of late there has been an enormous increase in demands upon its resources.

Legally incorporated and registered, the R.A.F. Benevolent Fund of the U.S.A., Inc., sponsored by reputable business men and others, has organized to send financial aid to the British Fund. It is the sole official representative in the United States of the British Fund. Its sponsors are underwriting all administrative expenses, and all subscriptions, donations and bequests will be forwarded IN FULL to the British Fund.

Local "Committees" of the R. A. F. B. F. of the U. S. A., Inc., are being formed all over the country under reputable sponsorship. Address inquiries and donations to: R. A. F. Benevolent Fund of the U. S. A., Inc., 515 Madison Avenue, New York City.

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Name.....

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(Continued from page 190)

possibly a relic of ancient Feudalism. Merging with them are the successful business people, the people with an inflated idea of their own importance. To me, it is faintly amusing, faintly annoying, something indicating "suparioritah." And the Yanks don't like it at all. It has the effect of producing a mild reverse flow of the libido, a mild inferiority complex that makes one feel uncomfortable. As I have no alphabet after my name, I am reminded of my low level of intelligence. It can be annoying, but with the mildest knowledge of psychology, it can be dispersed.

Americans are easy to understand and easy to get on with. We of the Dominions and Colonies hit it off well with them. For a multitude of reasons American influence is strong in Australasia. A large proportion of the magazines we read are American; the movies, books, all help.

Yet it is England, far away, that calls the majority of us most strongly. No words can adequately describe the profundity of our love for England and all she stands for. We talk about going home—to England. Without a protest, this overcrowded isle accepts us, for life, if necessary.

Anything that I could ever do to remove or disperse misunderstandings between Americans and Englishmen, I would do with all my heart, not only now, but at any time. There should be an Anglo-American Union, a getting together of the English speaking peoples. In the past there has been bitterness, but why should we keep resurrecting the ghosts of the past? Why not bury them once and for all?

I was glad to have that copy of the letter you sent to the Editor of *The Aeroplane*. It was, as you said, a pretty good cross-section of American opinion. I read it through carefully a number of times and I showed it to my friends. It impressed, it amused, it was generally well received; the charges preferred against the Englishman have often been repeated. The War Debt, that still rankles, the stuckupness of the English, their insularity, their hypocrisy, the way they go about as if they owned the whole world. Yes, I have heard all these charges almost as long as I can remember, I have heard that Americans want to create a language of their own—and so one could go on. It is not for men to deny them, maybe they are true enough, England is not all lily-white; there are smudges.

One is tempted to ask why America always finishes up more or less hand in glove with the intolerable, unspeakable English? Is it purely from self interest? Are there no emotional ties? Destiny brings us together so that a great purpose may be served, but I like to think that there is something more than destiny, something intangible and yet real, a voluntary coalescence in times of stress brought about by an interweaving of ideals of tolerance, freedom and liberty, a sublimation of self, a burning away of bitterness.

B-26 TOOLING

(Continued from page 134)

The holes are drilled with a drill press which travels on rails over the entire spar fixture. Such machines have speeds from 110 rpm to 3600 rpm. All mountings are on ball bearings and the press can be moved with minimum effort. When drilling, the machine tool is locked to the rails with a quick-locking arrangement.

After holes are drilled, the parts are removed from the jig, burred and set up in a riveting fixture, where the chords are accurately held and the parts riveted together with a pneudraulic-squeezer riveter, the weight of the squeezer yoke being supported by spring balancers. This riveted assembly is then put in the third-operation fixture, where all the hinge and major attachment fittings are located, the hinge fitting being held in place with gauges and then drilled and reamed through jig plates with travelling drill presses. This allows all the stretch-out, resulting from riveting, to take place before the major connecting points are located. The spars are then placed in wood holding fixtures and the fitting bolted into place.

The leading edge of the outer wing is a sub-assembly, and is attached with a piano hinge at the top and bottom of the front spar. Thus maintenance crews later need only to pull out the long hinge wire to gain quick access to the plumbing and wiring in the leading edge. Half of the hinge is attached to the leading edge and half to the top and bottom of the front spar chord. There are 5 fixtures exactly alike for producing leading edges for each right and left wing. And for each there are 20 first-operation right and left outer wing assembly fixtures, yet any leading edge, upon reaching final assembly, will exactly match any wing. The outer wing is 26 ft. 4 in. long, and the total over-all tolerance is .010″ to match the hinges. This is controlled by slots and nibs on the hinges.

The fuselage of the B-26 is built in 4 separate sections—nose, center, forward tail and aft tail. The tail section is made in two pieces and joined in the factory for manufacturing purposes; the other two splices are to disassemble the ship so it can be shipped by rail or boat. The shipping splices are joined together by a 5/16″ bolt, have a clearance of +.002″ and are spaced approximately 2″ apart around the circumference of a frame approximately 90″ in dia.

There are three groups of these fixtures in which the fuselage sections are assembled, and the splice holes drilled and reamed. They total 30 fixtures. Sections coming out of any of the fixtures are readily assembled without hand reaming or drilling the bolts in place. This is necessary if spare parts are to be shipped and assembled in the field, during an emergency.

Altogether there are 88 large steel assembly fixtures for producing the major components. These fixtures have a total weight of 400 tons, and occupy over 100,000 sq. ft. of floor space. Most of the accurate parts of the large fixtures are tooled and made with master jigs so they produce duplicate assemblies.

Thus has Martin taken time by the forelock. The company's national defense effort is considerably advanced. A new degree of accuracy and interchangeability has been introduced for aircraft, and evidence is given that the industry is well able to produce quality military airplanes in quantity. Besides, such methods look toward the widening of an increasingly serious bottleneck—that of trained personnel.

BALANCING PROPELLERS

(Continued from page 109)

at the rear of the diaphragm. The entire tubular structure with attached screen mesh is free to oscillate about a vertical axis formed by the two elastic supports which may be seen near the top and bottom of the rear view of the diaphragm. In the front view of the diaphragm, the two pickups which translate oscillatory motion of the diaphragm into electrical voltages may be seen supported on outriggers at the periphery of the diaphragm.

Two basic, and to some extent conflicting, requirements governed the design of the diaphragm structure. First, because the resistance of the diaphragm to motion produced by unbalanced blade thrust is proportional to the inertia of the structure, it was necessary to design for the minimum moment of inertia about the pivot axis in order to obtain adequate sensitivity of unbalance indication. Second, because the pickups indicate motion of points on the periphery of the structure, it is essential that this motion be representative of that of the entire diaphragm, unaffected by possible local distortions of the structure.

To aid in accomplishing the second objective, the natural frequency of the diaphragm structure was made considerably higher than the frequency of blade passage. This avoids resonance between important aerodynamic frequencies and the natural period of the structure, and consequent errors in the indicating system, which system, as pointed out in Part II, is immune to periodic disturbances at other than the desired single frequency of rotation, if these disturbances are not large. The high natural frequency also avoids resonance between the natural period of the diaphragm and the rotational fre-

quency. This is necessary because these disturbances would be transmitted with full value to the indicating system. Forty cycles per second appeared to be lowest permissible natural frequency of the structure suitable for balancing three-blade propellers at 600 rpm.

From the above it is evident that the problem was one of designing a structure with the minimum inertia consistent with adequate rigidity. How well this was accomplished is indicated by the fact that the moment of inertia of the entire movable structure about the pivot axis is 1370 lb. ft.^{2}, while the corresponding moment of inertia of a three-blade propeller of equal diameter is 2200 lb. ft.^{2} The weight of the movable diaphragm structure is 120 lbs. The low inertia and high rigidity were accomplished by loading a ¼ scale model of the diaphragm and adjusting the sizes of individual members until a structure of almost uniform strength was attained.

Screen mesh, in preference to solid sheeting, was used to cover the diaphragm structure to permit axial air flow through the diaphragm and reduce the possibility of radial flow. Radial flow evidently would result in a different distribution of angle of attack along the blade than that existing in normal flight and would probably result in errors in true unbalance indications. The mesh of the screen was chosen somewhat arbitrarily so that the pressure drop across the diaphragm is about ¼ of that corresponding to the velocity head approaching it. Although the perforated construction sacrifices some sensitivity of unbalance indication, this was believed preferable to the probable inaccuracies produced by excessive radial flow.

Operation of the Machine

Fig. 17 shows a simplified diagram of the essential components of the machine. The diagram is identical with fig. 10, in Part II of this article, with the exception that the aerodynamic diaphragm and two pickups for measuring its motion have been added to fig. 17. These pickups are switched into the circuit to replace those which measure the propeller arbor motion during mass unbalance determinations. Since the functions of the principal parts of the electrical network were explained in Part II, only the procedure for calibrating the machine and measuring the unbalance in a three-blade propeller will be outlined here.

The two pickups move in opposite directions but are connected so their combined output enters the network. Two pickups are used to reduce the errors produced by vibration of the mounting base but otherwise only one is essential to the operation of the scheme.

For calibrating, switches 9 of fig. 17 are placed in the A position and switches 1 and 2 in the C position to throw the compensating generator A-A into the network. Switch 3 is kept in the 90° position throughout the entire procedure. The potentiometers in series with the compensating generators are adjusted so that voltages from the latter completely nullify the pickup voltages produced by initial thrust unbalance. This is the equivalent of installing a perfectly balanced propeller and the machine is now ready for calibrating the indicating system to read unbalance in the desired units.

Measurement of the thrust unbalance now involves selecting one of the blades as a reference and comparing successively the thrust moments of the other two blades with that of the reference blade. To accomplish this, assume that Blade 3 is to be used as a basis for comparison. Blade 1 is now adjusted to a known angle difference with respect to the other two blades; for example, 1° higher. Additional voltages will now be produced by the pickups. The measuring generator stator is now rotated until a zero wattmeter reading is obtained. In this generator position the network will not read unbalance in Blade 1 and it is, therefore, the correct generator setting for reading the unbalance produced by *either* Blade 2 or 3. As Blade 3 has been chosen for reference, the generator setting is the correct one for measuring the correction which must be applied to Blade 2.

If the generator stator is now rotated 120° in the direction in which the blades are numbered, its position will be that in which the network will not measure unbalance in Blade 2; that is, it is in the proper position for measuring the unbalance in *either* Blade 1 or 3. Again, since Blade 3 was selected for reference, this generator position is the proper one for determining the correction to be applied to Blade 1. With the generator in this position, the potentiometer 8 is adjusted so the wattmeter indicates the blade angle difference which was applied to Blade 1; that is, 1°.

The machine is now ready for measuring the initial propeller unbalance, and, if the compensating generator is eliminated from the circuit by throwing switches 1 and 2 to the M position, the wattmeter will read the angle correction to be applied to Blade 1. If the generator stator is now rotated 120° to the original position, the wattmeter will indicate the angle correction for Blade 2.

Adjusting Blades 1 and 2 in accordance with the indications of the machine will make the thrust moments produced by these blades equal to that of Blade 3 and the propeller will be in complete aerodynamic balance. Switches 9 may now be shifted to the D position and the entire equipment used to measure the mass unbalance of the propeller in accordance with the procedure described in Part II of this article.

Sensitivity and Limitations

Design calculations show that the machine should be capable of indicating with fair accuracy aerodynamic unbalance equivalent to blade angle differences of .015° in an 11.5′ dia. propeller. Although several inherent errors, such as vibration of the mounting base and unsteady airflow through the propeller and diaphragm, tend to reduce this sensitivity, it is expected that aerodynamic unbalances equivalent to blade angle differences of less than 0.1° may be readily detected. The calculations in Part I show that the residual thrust unbalance resulting from a blade angle difference 0.1° under normal flight conditions is small in comparison with the mass moment unbalance permitted by errors in alignment of the propeller on the engine shaft. This sensitivity of the equipment for measuring aerodynamic unbalance is nearly equal to that of the Dynetric machine for measuring mass moment unbalance.

It is to be expected that the airflow through a propeller which is running on the balancing machine is not entirely equivalent to that existing in actual flight. It is too early to predict to what extent these differences in flow characteristics will influence the effectiveness of the results produced by the balancing machine. However, it is planned to study the effect of this variable in flight tests on an airplane known to be sensitive to propeller unbalance by comparing the performance of aerodynamically balanced propellers with those which have been deliberately unbalanced by known amounts.

The most serious difficulty which has been encountered in preliminary tests on both the Dynetric and aerodynamic equipment has been with extraneous motions of the balancing arbor and of the aerodynamic diaphragm which are produced by unsteady airflow through the propeller. These non-periodic motions produce equivalent wavering of the wattmeter needle, thus reducing the accuracy with which the instrument can be read and the inherent sensitivity of the equipment. The preliminary tests indicate that the difficulty may be reduced considerably by proper streamlining of the balancing machine and by straightening the air flow at the entrance and exit to the balancing chamber with honeycombs. A 1/12 scale model of the balancing equipment with which smoke filament tests are currently in progress, is being used to determine the optimum arrangement of the streamlining in order to reduce the turbulence within the balancing chamber.

The author wishes to acknowledge the assistance of J. G. Baker of the Baker Manufacturing Co., and consulting engineer for Hamilton Standard Propellers, from whose design reports many of the data concerning the aerodynamic balancing equipment were taken; and that of John Calvin, Assistant Project Engineer, under whose supervision the model and full-scale balancing tests were made.

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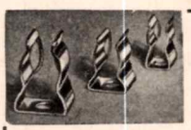

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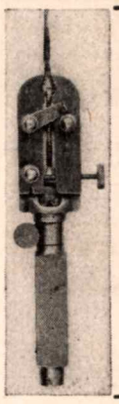

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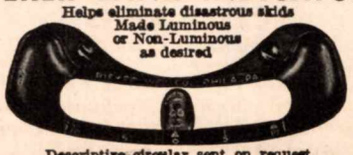

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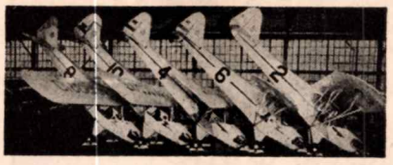

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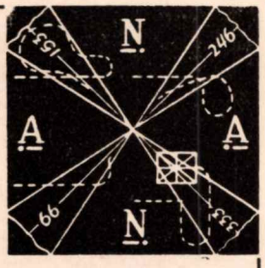

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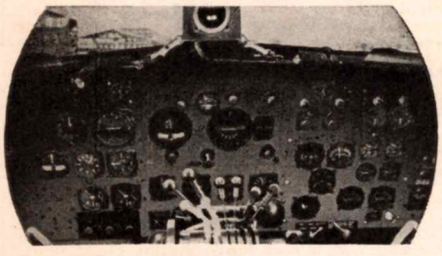

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